SERUM IMMUNOGLOBULIN LEVEL IN KIDS AND ITS ASSOCIATION WITH GROWTH AND MORTALITY

BY

NANDAKUMAR P.

THESIS

Submitted in partial fulfilment of the
requirement for the degree

Master of Veterinary Science

Faculty of Veterinary and Animal Sciences
Kerala Agricultural University

Department of Animal Breeding and Genetics
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
Mannuthy - Trichur

1981

DECLARATION

I hereby declare that this thesis entitled "Serum immunoglobulin level in kids and its association with growth and mortality" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me any degree, diploma, associateship, fellowship or other similar title of any other university or society.

Place: Mannuthy Signature of the candidate:

Date:31-7-1981. Name of the candidate: P.NANDAKUMAR

CERTIFICATE

Certified that this thesis, entitled "Serum immunoglobulin level in kids and its association with growth and mortality" is a record of research work done independently by Sri.P.Nandakumar under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

Mannuthy,

31-7-1981.

Name of the Guide: DR.C.A.RAJAGOPALA RAJA,
B.V.Sc.,M.Sc.,Ph.D.
(Chairman, Advisory Board)
Associate Professor,
Department of Animal Breeding and Genetics.

ACKNOWLEDGEMENTS

I am greatly indebted to Dr.C.A.Rajagopala Raja, Associate Professor, Department of Animal Breeding and Genetics and major adviser for his valuable guidance and the keen interest shown in this study.

I am immensely grateful to the following members of the advisory committee for their help and co-operation

Dr.B.R.Krishnan Nair, Geneticist, A.I.C.R.P. on goats for milk production, Mannuthy.

Dr.K.Pavithran, Associate Professor, Department of Dairy Science

Dr.M.Krishnan Nair, Dean, Faculty of Veterinary and Animal Sciences.

I wish to express my deep sense of gratitude towards late Dr.T.R.Sharathan Namboodiripad, for the encouragements and help during the early phases of this work as the then adviser.

I am also thankful to Dr.G.Mukundan, Professor and Head, Department of Animal Breeding and Genetics for the interest shown in this study. Thanks are also due to Dr.K.N.Muraleedharan Nair, Associate Professor of Surgery for the help. Sri. Balakrishnan Asan had been

helpful in statistical analysis of the data. The staff of Department of Animal Breeding and Genetics and A.I.C.R.P. on goats for milk production were very much co-operative.

I am grateful to many of my friends without whom this work would not have been complete.

The credit of typing the manuscript goes to Shri. V.T. Kurian.

NANDAKUMAR P.

Mannuthy,
31-7-1981.

LIST OF TABLES

Table No.	Title
3.1.	Average O.D. values obtained for different strengths of added gammaglobulin.
4.1.	Pre colostral Ig level in kids.
4.2.	Trend in bihourly Ig levels from birth to 24 hours.
4.3.	Analysis of variance for partitioning the effect of periods and animals.
4.4.	Trend in serum immunoglobulin level from birth to eight weeks of life in kids.
4.5.	Analysis of variance for partitioning the effect of periods and animals.
4.6.	Mean Ig level of three breed groups.
4.7.	Analysis of variance for studying the effect of breed on serum Ig level.
4.8.	Analysis of variance for studying the effect of type of birth in serum Ig level.
4.9.	Effect of serum Ig level on mortality of kids.

LIST OF FIGURES

Figure No.	Title
3.1	Standard curve for serum immunoglobulin levels.
4.1.	Trend in serum immunoglobulin levels from birth to twenty four hours.
4.2.	Trend in serum immunoglobulin levels from birth to eight weeks

TABLE OF CONTENTS

Sl.No.	Title	Page No.
1.	Introduction	1 - 5
2.	Review of literature	6 - 26
3.	Materials and methods	27 - 36
4.	Results	37 - 46
5.	Discussion	47 - 54
6.	Summary	55 - 56
7.	References	i - ix
8.	Appendix	x - xiv
9.	Abstract	

INTRODUCTION

INTRODUCTION

Immune response, the strategic defense system in the fight against microbial and antigenic invasions, is of primary importance to the survival of an animal. An animal is constantly exposed to pathogenic microorganisms and other antigenic substances from its environment. Immune response is the cellular and humoral responses of the body to certain intrinsic and extrinsic factors. The survival of the animal in the struggle against the microbial and antigenic invasions is dependant on its immune response. Animals with poor immuno competence will not be able to combat microbial invasions and hence may succumb to such infections. On the other hand, those with good immune response or efficient immune system can survive even acute infections caused by virulent organisms.

Immune system

The functional immune system comprises of cells of bursal or bone marrow origin and cells of thymic origin. The cells of thymic origin (T-lymphocytes) are concerned with cell mediated immunity. The B-lymphocytes (cells of bursal or bone marrow origin) are mainly concerned with

humoral immunity. These cells, on antigenic stimulation, are capable of active division to produce plasma cells which are concerned with the synthesis of antibodies. Antibodies are present in many tissues and fluids of the body. Antibodies come under a family of related proteins called gammaglobulins with over lapping physicochemical properties. In strict sense immunoglobulins (Ig) are gammaglobulins committed to act against specific antigens. But both terms are usually used synonymously. Four distinct classes of Ig have been recognised in goats namely IgG_1, IgG_2, IgA and IgM (Feinstein and Mobart, 1969; Pahud and Mach, 1970). All these Ig have antibody activity stressing the importance of total Ig as a measure of the humoral immune status of an animal.

Immune status

In cattle, it is well established that sufficient levels of gammaglobulin is essential for the health, better performance and survival. As early as 1960, Ross and co-workers had found that lines of Zebu cattle resistant to helminthiasis had higher gammaglobulin compared to susceptible lines. Halliday and Williams (1980) reported that cows with normally high levels of serum Ig

generally produced more antibodies in response to an antigenic challenge. Low levels of Ig have been reported to be associated with many diseases including neoplasms (Jacobs et al. 1980).

A neonatal mammal is incapable of mounting an immune response effectively. It has to depend on the passive immunity provided by the mother for disease resistance and survival. In ruminants like cattle, sheep and goat the transfer of passive immunity to the neonate occur mainly via, colostrum of the dam. Many workers have stressed the importance of colostrum in the prevention of colibacillosis in calves and showed that mortality was higher in calves with low serum gammaglobulin levels. The neonatal calves with high serum Ig level survive diarrhoea and death. Agammaglobulinaemia or hypogammaglobulinaemia is found in association with neonatal infections and death not only in cattle, but also in foals, piglets and lambs.

Scope

Surprisingly, little work in this regard has been done in goats which form a major portion of livestock, especially in Kerala. Neonatal infections, subsequent poor performance and mortality have been a serious

problem in the development of intensive goat husbandry. Neonatal infections and mortality in kids have been reported from all parts of the world. Ranatunga (1971) reported an overall mortality of 28.4 per cent in kids below 6 months of age. Manomohan et al.(1979) found that 92.96 per cent of the 767 kids dying of various causes were below three months of age. The neonatal mortality and poor performance in kids may be also due to a defective transfer of passive immunity from the mother. The age at which maximum infections and mortality occur in kids, arouses strong suspicion in this direction. Hence, the studies on transfer of passive immunity from the dam to the kid, the change over from passive to active immunity in the kid, the association among passive immunity level, performance and mortality are all important.

Objective

The present investigation was undertaken to study

1. The pre colostral Ig level in kids.
2. The trend in post colostral Ig level in kids from birth to 24 hours after birth at bihourly intervals, to locate the post colostral peak of serum Ig level in kids and to find its magnitude.

3. The trend in serum Ig level from birth upto 8 weeks of age.

4. The factors affecting post colostral peak level of serum Ig such as genetic group, birth weight and type of birth.

5. The association between post colostral peak of serum Ig level and mortality of kids below 2 months of age.

6. The effect of serum Ig level on gain in body weight.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Immunoglobulins

An animal is being invaded constantly by micro-organisms and other foreign antigens from its environment. Immune response is of primary importance to the survival and better performance of the animal from these harmful antigenic invasions. Immune response is the cellular and humoral responses of the body to certain intrinsic and extrinsic factors. An animal with poor immune responsiveness would not be able to combat microbial invasions, may succumb to infections and may even die. Osburn et al. (1974) pointed out that many diseases in animals, including certain neoplasms were due to the failure of hosts' immune system.

According to Asherson, (1976) immune system essentially consists of cells of thymic origin (T-lymphocytes) and cells of bursal or bone marrow origin (B-lymphocytes). The T-lymphocytes are mainly concerned with cell mediated immunity. The depletion of pool of thymus derived cells, resulted in general unresponsiveness in cell mediated immunity. The cellular immunity could not be passively transferred as humoral immunity. The B-lymphocytes or lymphocytes of bone narrow origin are concerned mainly

with humoral immune response. Removal of bursa in chicken, in early life led to agammaglobulinaemia and absence of plasma cells. The antigen-sensitive B cells are required for primary antibody response. These cells, on antigenic stimulation, are transformed into plasma cells, which synthesise antibodies against that particular antigen.

When an antigen was introduced into an animal body, antibody production in the animal followed a characteristic pattern as (1) The lag-phase (2) the logarithmic phase (3) the plateau and (4) the phase of decline. The initial production of antibodies after the first immunisation was markedly different from that of antibody production after the second immunisation. The former is called the primary immune response and latter, the secondary or anamnestic response. The primary response was sluggish short lived and comprised of 19S IgM immunoglobulins. Secondary response was swift, prolonged, powerful and composed mainly of 7S IgG immunoglobulin (Park and Good, 1974).

Antibodies come under a family of related proteins called gammaglobulins with overlapping physico-chemical properties. Immunoglobulins (Ig) are proteins of animal origin with known antibody activity as well as other

chemically related normal and pathological proteins. Thus in strict sense all gammaglobulins are not immunoglobulins. Only when gammaglobulins are committed to set against specific antigen, they are truly be called immunoglobulins. But both terms are used synonymously. Structurally an immunoglobulin molecule consists of one or more units formed of two identical heavy and two identical light chains held together by disulphide bonds. The heavy chains are designated corresponding to five main Ig classes in man, as gamma (IgG), Mu (IgM), alpha (IgA), delta (IgD) and epsilon (IgE). The light chains are of two types kappa and lambda. The portion of each chain where amino acid configuration is constant is called constant region and that part where the amino acid sequence varies from molecule to molecule is called variable region. Diversity of antibodies is due to variation in variable region (Asherson, 1976).

Four distinct classes of Ig have been identified in goat, all of which have got antibody activity. They are IgG_1, IgG_2, IgM and IgA (Feinstien and Hobart, 1969; Pahud and Mach, 1970). Since all the immunoglobulin classes in goats have antibody activity, quantitation of total Ig is of significance in assessing the humoral

immune status. Young goats had lower gammaglobulin level compared to adults (Castro et al. 1977). Goats at six months had 23.8 mg/ml of gammaglobulin as against 34 mg/ml of serum in goats of 2 years age. Desiderio et al. (1979) found 26.65 ± 7.13 per cent of serum proteins as gammaglobulin in adult goat serum.

A neonatal animal is incapable of mounting an immune response effectively. It has to depend on the passive immunity provided by the mother for disease resistance and survival. The transmission of passive immunity from mother to young may occur before birth, after birth or at both the phases. Based on the passive transfer of immunity from mother to young, animals can be classified into three groups. In the first group comprising of lagomorphs and primates, the transmission of passive immunity from the mother to the young one occurs in utero. The neonates of the second group consisting of ungulates receive their passive immunity via the colostrum of the mother. The third group, consisting of dog, cat, rat, mouse, guinea pig etc., derives their passive immunity both in utero and via colostrum of the dam (Brambel, 1970; Butler, 1973).

Neonates of ruminants including goats, derive their passive immunity via colostrum of the dam. Colostrum of ruminant is a rich source of immunoglobulins. Larson

and Kendall (1957) found that 70-80 per cent of first colostral whey proteins of Guernsey and Hostein were immunoglobulins. Earlier, Askonas et al. (1956) had found the composition for goat colostrum as show in table 2.1.

Table 2.1. Distribution of proteins in goat colostrum

Time after parturition (hours)	Total amount of protein mg/ml	Percentage of gammaglobulin
1	105.0	62%
11	215.0	25%
14	131.0	26%

Askonas et al. (1956)

Feinstien and Hobart (1969) were able to find that IgG1 was selectively concentrated in goat colostrum. Aguilera (1971) reported that averages of immunoglobulin concentration in bovine colostrum after 0, 12 and 24 hours of parturition were 129.3±5.03, 97.8±4.54 and 57.5±27.3 mg/ml respectively. Bhatia and Ganguli (1977) found that IgG_1 of 1st day colostrum of Sahiwal and Sahiwal Brown Swiss cross were 33.33 and 31.54 mg/ml, respectively. Hunter et al. (1977) reported that ewe colostrum at the time of parturition had 115±10.1 mg/ml of gammaglobulin. Micusan and Barduas (1977) were able

to find 53.27±5.3 mg/ml of Ig in goat colostral whey of which 50.85±4.9 mg/ml was IgG_1 and only 2.27±1.32 mg/ml was IgG_2. Earlier, Balfour and Comline (1962) had found that besides immunoglobulins colostrum contained factors which enhanced immunoglobulin absorption, like trypsin inhibitor.

2.1. Pre-colostral serum immunoglobulin levels

The uterine epithelium is an intact barrier in the placenta of ungulates and there is little or no placental transfer of immunoglobulins. The placenta of ruminants like cattle, sheep and goat are cotyledonary in form and syndesmochorial in structure. The chorionic trophoblast is in direct contact with uterine subepithelial connective tissue. There are about 160-180 caruncles in the uteri of goats (Brambel, 1970).

Earlier, Famulener (1912) could find no appreciable amount of haemolysins in the sera of new born kids, of goats that had been actively immunised to sheep red cells, before suckling. Reyman (1920) confirmed that goats, immune to *E. coli*, typhoid, rabbit red cells and horse red cells, did not transmit agglutinins to their kids before suckling. Neubauer and Schone (1979) could find

no insulin binding antibodies in the sera of neonatal kids that were born to goats actively immunised to insulin, before suckling.

Though specific antibodies could not be detected in the sera of neonatal ruminant prior to suckling, gammaglobulins have been detected even in foetal ruminants. Aguilera (1971) determined immunoglobulin content in the sera of 27 calves at birth. The author could find an average gammaglobulin level of 2.9±1.6 mg/ml in the sera of calves at birth. Bush et al. (1971) found that the average gammaglobulin level in the sera of 27 precolostral calves were 2.9 mg/ml. Merriman (1971) detected IgM, IgG_1 and IgG_2 in the sera of precolostral calves. But IgA could not be found in the precolostral serum. Reid (1972) reported that precolostral lamb serum contained 2 ZST units of gammaglobulin. Schultz (1973) found that 90 per cent of bovine foetuses of 235 days gestation to birth had Ig in their sera. Osburn (1973) reported that most animals were born with a minimal Ig in their serum. Jalnapurkar et al. (1976) reported that serum IgG level in 11 buffalo calves before suckling ranged between 0.17 and 1.72 mg/ml. Hunter et al. (1977) found that average precolostral serum Ig level in 49 lambs was 0.07 mg/ml. Clover and Zarkower (1980) could not find appreciable quantities of gammaglobulin in precolostral calf sera.

2.2. Post colostral serum Ig levels.

Ig are mostly availed to the neonatal kid via colostrum. Apart from Ig, colostrum contained factors which favour absorption of Ig as trypsin inhibitor (Balfour and Comline, 1962). Absorption of colostral Ig is a non selective process and even molecules of comparable size of IgG were equally well absorbed (Balfour and Comline, 1959; Pierce, 1961; Hardy, 1969 and Brandon et al. 1971). Stott and Menefee (1978) reported that IgM is preferentially transported across the intestinal barrier.

2.2.1. Time of attainment of post colostral peak

Famulener (1912) actively immunised pregnant goats with sheep red cells and found that their kids after ingesting colostrum rapidly acquired a relatively high antibody titre in their serum. Reymann (1920) found that antibodies to Escherichia coli, typhoid, rabbit and horse-red cells were transmitted to kids via colostrum. Maximum titres were found in the sera of the kids as early as 11 hours after birth. Husband et al. (1972) found that peak concentration of IgA and IgM were at 12 hours after feeding colostrum, whereas IgG and IgG_2 reached the peak level only at 24 hours in calves. Earlier Aguilera (1971) reported that post colostral peak level of serum Ig was reached in 24 hours after first suckling in calves. Bush et al. (1971) reported a gradual decline

of serum Ig levels in neonatal calves after reaching a peak level at 24 hours after suckling. Reid (1972) found a peak level of 27.4 ZST units at 24 hours after feeding colostrum to lambs. Husband et al. (1972) reported that post colostral peak serum IgM and IgA in calves were reached 12 hours after first suck, whereas it was 24 hours for IgG_1 and IgG_2. According to Logan et al.(1974) post colostral peak of serum Ig was reached at 24 hours after suckling. Ducker and Fraser (1976) found that gammaglobulin concentration in lamb sera reached a peak 24-72 hours after the time of first suck. Sawyer et al.(1977) found that all lambs at 24 hours after birth absorbed Ig nearly to the same extent. Halliday et al. (1978) reported that a rapid increase in serum IgG_1 level of calves occurred after ingesting the colostrum during the first 10 hours and a plateau was reached between 13-14 hours which continued upto 40 hours. Neubauer and Schone (1979) found that post colostral peak of serum Ig in kids was reached before 24 hours after ingesting colostrum. Clover and Zarkower (1980) found that post colostral peak in serum Ig level in calves were reached 24 hours after feeding colostrum.

2.2.2. Trend in serum Ig level from birth to 24 hours and magnitude of post colostral peak

Reymann (1920) found that antibody titre in the sera of new born kid sometimes exceeded the titre of mother's serum, but did not usually exceed the titre of colostrum. Aguilera (1971) fed colostrum to calves at the rate of 5 and 7.5 per cent of body weight on first and second days of life, respectively. The average Ig level in colostrum after 0, 12 and 24 hours, respectively, were 129.3±50.3, 97.8±45.3 and 57.5±27.3 mg/ml. Average Ig level in calf blood increased from 2.9±1.6 mg/ml to a peak of 15.5±5.0 mg/ml at 24 hours. Bush et al.(1971) fed colostrum to 27 calves at a rate of 2.5 per cent of body weight at birth and 12 hours after birth and 3.75 per cent of weight at 24 and 36 hours. Average blood gammaglobulin level increased from 2.9 mg/ml before initial feeding to 15.4 mg/ml at 24 hours and declined slowly thereafter. Reid (1972) recorded mean gammaglobulin level of 72 new born lambs as 2 ZST units at birth which increased to 27.4 ZST units at 24 hours after birth. According to Findlay (1973) mean Ig content of one or two day old lambs was generally higher than that of the dam. In lambs, Hunter et al. (1977) found an average IgG level at 24 hours as 35.6 mg/ml of serum. Logan and Irwin (1977) recorded an average Ig level of 19.1±1.1 ZST units in 84 lambs at 24 hours after birth. In a study

on 983 calves. Bringole and Stott (1980) found that, post colostral peak level of IgG and IgM ranged from 0-63 mg/ml and 0-15 mg/ml respectively. Clover and Zarkower (1980) could find a peak serum gammaglobulin level of 13.6±1.2 mg/ml.

Table 2.2. Gammaglobulin level from birth to ninety six hours.

Hours after birth	0	6	12	24	48	72	96
Serum gamma-globulin level mg/ml	0	8.6 ± 1.3	9.6 ± 1.7	13.6 ± 1.2	13.3 ± 1.6	12.0 ± 2.0	12.2 ± 1.6

Clover and Zarkower (1980).

2.3. Trend in serum immunoglobulin level from birth to eight weeks of age.

Hansen and Phillipps (1947) found that when calves were raised without access to colostrum the various blood serum protein factors did not approach normal levels until the animals were 8 weeks of age. Smith and Holmes (1948) observed that the globulin fractions acquired from colostrum decreased steadily in calves from 2 days of age, reaching about half the initial concentration after 20 days. They reported that calves

at 50, 87 and 122 days of age had 0.6, 3.7 and 4.1 mg/ml Ig respectively. Pierce (1955) in electrophoretic and serologic studies on the transmission of Trichomonas foetus agglutinins via colostrum to calves and its subsequent elemination from circulation of calves found that production of natural agglutinin occured between 30-60 days by the calves. The author further showed that autogenous production of gammaglobulin by the calf began soon after birth. Klaus et al. (1969) found the serum Ig concentration in mixed European breed as shown in the table 2.3.

Table 2.3. Serum immunoglobulin level (mg/ml) in calves of various ages.

Class of Ig	Age of calves				
	0 day	Ist day	2nd day	4th day	7th day
IgG	1.2	22.30	22.60	20.10	16.90
IgM	0.1	1.26	1.16	0.90	0.70

Klaus et al. (1969).

The Ig levels in Jersey and Holstein calves of different age groups as found by Tennant et al. (1969) is given in table 2.4.

Table 2.4. Change in Ig level (mg/ml) in serum of calves of different age groups.

Breed	Precolostral	1-5 days	6-10 days	11-15 days	16-25 days	26-35 days	36-45 days	120-200 days
Jersey	3.0	30.0	26.0	24.0	18.0	16.0	15.0	16.0
Holstein	2.0	13.0	10.0	8.0	9.0	9.0	9.0	15.0

Tennant et al. (1969).

Logan et al. (1974) reported that serum Ig level after reaching a peak at 24 hours became minimum at 2-5 weeks and rose again reaching an adult level at 12 weeks of age. Earlier, Husband et al.(1972) reported that endogenous production of IgG_1, IgG_2 and IgM began by 8-16 days whereas synthesis of IgA began by about 64 days. Logan et al.(1974) found that calves with low serum Ig level began synthesising Ig within a week after birth, whereas calves with high serum Ig level did not synthesise Ig until they were 4 weeks old. Ciupercescu (1977) reported that mean IgG concentration of three day old lambs were considerably higher than their dams. It fell by more than half in following two weeks, remained about this level for a month and thereafter increased slowly but was still significantly lower than adults. Neubauer and Schone (1979) reported that anti-insulin antibody titre in kid serum reached a peak before 24 hours but was dropped

by about 50 per cent of the original level in eight days. Clover and Zarkover (1980) presented the trend in serum gammaglobulin level in neonatal calf sera from 0-96 hours after birth as given in table 2.5.

Table 2.5. Serum gammaglobulin level (mg/ml) in sera of calves.

Time in hours	0	6	12	24	48	72	96
Gammaglobulin level	0	8.6 ± 1.3	9.6 ± 1.7	13.6 ± 1.6	13.3 ± 1.6	12.0 ± 2.0	12.7 ± 1.6

Clover and Zarkover, (1980).

2.4. Factors affecting post colostral peak of serum Ig levels.

2.4.1. Breed

Halliday (1968) reported that the concentration of proteins and gammaglobulin were higher in Merino lambs, compared to Finish landrace, Scottish blackface and Merino x Cheviot lambs. Tennant et al. (1969) found that serum Ig levels of 1-5 days old Jersey calves were on an average 30 mg/ml whereas Holstein calves had 13.0 mg/ml. Penhale and Christie (1969) found a higher gammaglobulin level in Indian breeds of cattle. Nair et al. (1979) reported that there was a significantly higher gammaglobulin level for Alpine x Beetal than for Beetal does.

2.4.2. Type of birth

Logan and Irwin (1977) found that mean serum gamma-globulin level was higher in singles than twins and higher in twins than triplets. The mean gammaglobulin levels were 21.4±2.6 ZST units for single lambs, 19.3±1.5 ZST units for twins and 13.7±2.2 ZST units for triplets.

2.4.3. Birth weight

Halliday (1976) attributed the higher Ig level of Finnish x Dorset lambs to the vigour of the lambs to suck colostrum. Halliday and Williams (1979) reported that the serum concentration of Ig after one hour of feeding colostrum was negatively correlated with birth weight of lambs.

2.4.4. Ig content of colostrum

The only source of Ig to the neonatal kid is via the colostrum of dam. Aguilera (1971) reported that there was a correlation of 0.7 between colostral Ig consumption and serum Ig level in calves. Balberz (1976) could find a marked variation in Ig content even among colostrum of healthy cows. Shubber et al.(1979) found a clear positive correlation between the total amount of Ig in lambs' serum at 30 hours after the first feed and the Ig consumed. Approximately 20-25 per cent of the Ig ingested was present in the lamb's serum at that time. Bringole

and Stott (1979) reported that even after feeding sufficient amounts of colostrum a high proportion of calves were hypogammaglobulinaemic.

2.4.5. Time of first feed of colostrum

Kruse (1970) reported that delaying the feeding of colostrum by 2 to 20 hours after birth resulted in diminishing the absorption coefficient by 50 per cent. Ducker and Fraser (1976) found that restriction of lambs from taking colostrum for the first eighteen hours did not reduce the absorption of gammaglobulin considerably.

2.5. Association of post colostral peak of serum Ig level with incidence of diseases and mortality.

Jensen (1893) stressed the importance of colostrum in the prevention of colibacillosis. The author showed that calves, fed only boiled milk on the first day post partum, died of acute diarrhoea where as calves fed colostrum survived. According to Gay et al.(1965) mortality was higher in groups of calves with low blood gammaglobulin levels. Butler (1969) stressed the importance of colostral transfer of Ig for the immunity to diseases. Eugester and Storz (1971) found that when calves deprived of colostrum were orally infected with the chlamydial agents of bovine polyarthritis, they rapidly developed fever, diarrhoea and polyarthritis whereas calves fed colostrum

showed less severe symptoms. Colostrum deprived calves fed sufficient whey and administered 0.26 g of IgM and 1.5 of IgG/30 kg body weight did not develop diarrhoea on intra peritoneal challenge with a pathogenic Escherichia coli serotype. Ranatunga (1971) suspected that the lack of milk in the dam may be the cause of high rate of neonatal mortality in kids. Fisher and Dela Feunte (1971) reported a high incidence of deaths in calves with low gammaglobulin level. In a study on lambs received for postmortum, using zinc sulphate turbidity test, Findlay (1973) reported a lower level of gammaglobulin in their sera compared to the normal healthy lambs. Thomas and Swaan (1973) reported a higher incidence of pneumonia and subsequent death in calves with lower gammaglobulin level in their serum. Campbell (1974) observed that 9/10 of the lambs fed colostrum survived, whereas 7/10 of colostrum and Escherichia coli fed lambs survived and only 5/10 of non colostrum fed lambs survived. Irwin (1974) found a higher incidence of diseases and death in calves with low gammaglobulin level.

Table 2.6. Gammaglobulin level and mortality in calves.

ZST units of Ig	No.of calves	death	Mortality percent
Below 20 units	169	19	11.24
Above 20 units	321	5	1.55

Irwin (1974)

Fisher et al.(1976) found a hyper catabolism of immunoglobulin in dying calves leading to an intravascular Ig depletion. A high level of immunoglobulin especially IgM protected calves from death due to neonatal salmonellosis.

Table 2.7. Association of serum Ig level (mg/ml) and Salmonellosis in calves.

	Mean serum Ig		Mean plasma Ig	
	Initial	final	Initial	final
Diarrhoeic & dying	7.19±1.56	4.59±1.00	15.7±4.90	7.8±2.3
Diarrhoeic & surviving	19.38±1.01	11.47±2.32	47.2±8.3	29.8±9.5
Non diarrhoeic & non infected	19.09±1.29	13.3±0.35	45.7±1.69	26.7±3.4
Normal infected	35.72	23.33	96.7	72.3

Fisher et al. (1976)

Mc Guire et al.(1976) reported that serum IgG1 concentration in calves below three weeks of age dying of infectious diseases, were lower than that of clinically normal calves. Fifty per cent of the dead calves had serum IgG1 concentration, two standard deviation below normal and 35 per cent of dead calves had one standard deviation below normal. Mc Nulty et al.(1976) reported

that feeding of colostrum sufficient to produce 30 mg/ml concentration of serum Ig level in calves prevented diarrhoea in them.

Table 2.8. Relationship between serum Ig level and diarrhoea in calves.

Total serum Ig level mg/ml	Total number of calves	TNumber of calves with diarrhoea
0-10	7	6
10-20	3	2
20-30	4	3
Above 30	6	0

Mc Nulty et al. (1976)

Sawyer et al.(1977) found that 14 per cent of 91 clinically normal calves were hypogammaglobulinaemic. Barber (1979) reported that feeding of six pints of colostrum after 24 hours reduced calf mortality due diarrhoea. Manomohan et al.(1979) suggested that failure of passive immunity from dam to kid may be a cause of high neonatal kid mortality. Bringole and Stott (1980) found a mortality rate of 13.3 per cent in 83 agammaglobulinaemic calves. The high rate of

survival (86.7%) of agammaglobulinaemic calves were attributed to the local effect of Ig on the intestine.

2.6. Effect of Ig level on body weight.

Ermekov et al.(1973) allowed 59 lambs to be nursed by their dams within 60 minutes, 28 lambs within 61-90 minutes and 14 lambs between 91 and 150 minutes. The respective daily gains in weight were 255 grams, 249 grams and 240 grams for the three groups.

Halliday (1976) reported that there was significant correlation between body weight gain and Ig level in sera of lambs. Ciupercescu (1977) found significant negative correlation between weight at 6-12 weeks and IgG_1 and IgG_2 concentration at 14 weeks ($r = 0.63$ and 0.368 respectively). Table 2.9 summarises the findings of Ciupercescu.

Table 2.9. Correlation between Ig subclasses and body weight.

Age	Ig sub class	Growth rate 0-6 weeks	Growth rate 6-12 weeks
3 days	IgG_1	-0.028	-0.260
	IgG_2	+0.168	+0.147
	IgM	+0.059	-0.22
6 weeks	IgG_1	-0.129	-0.314
	IgG_2	+0.040	+0.083
	IgM	+0.108	+0.229
14 weeks	IgG_1	-0.245	-0.630
	IgG_2	-0.224	-0.368
	IgM	+0.316	+0.151

Ciupercescu, 1977.

Halliday et al. (1978) observed a significant correlation between the concentration of classes of Ig in the serum and daily weight gain. For each mg of IgG_1 there was an increase of 5.5±2.00 g in daily gain upto 42nd day and an increase of 22±80.3 g in total weight gain at 42 days.

MATERIALS AND METHODS

MATERIALS AND METHODS

Choice of method of estimation of Ig level and general procedure

Male kids belonging to All India-Co-ordinated Research project on goats for milk production, Kerala Agricultural University, Mannuthy, born during the period from 3.7.1980 to 6.2.1981 were considered for the study. Different breed groups with varying numbers were utilised for each part of the study. Hence the details regarding choice of animals has been given along with description of procedures involved. One pre-colostral kid was purchased from the project for collection of pre-colostral serum. Zinc sulphate turbidity test was preferred for the quantitation of Ig in sera of kids. It has the advantage of being fast. It is cheap and loss of accuracy is minimum.

Collection and handling of serum

For collection of blood, animals were properly secured and the jugular vein was punctured using a sterile hypodermic needle. Five millilitres of blood were collected from each animal in separate collection tubes labelled and transferred to the laboratory without disturbing the samples. For collecting blood at bihourly intervals, blood was collected by catheterising the cephalic vein. After collecting the blood the tubes were kept at

room temperature for 2-3 hours for clot formation. When firm clot was formed, the clot was separated from the sides of the tube without disturbing the clot using sterile sticks. Then, the tubes were kept in refrigerator till clear serum accumulated. The sera clear of clot were then poured into centrifuge tubes with individual labelling and were centrifuged at a speed of 1500 revolutionsper minute for 15 minutes. The supernatent serum was then pippetted out into individual sterile tubes of 5 ml capacity. The serum was then stored in freezer. When needed the stored samples were thawed to room temperature. Gammaglobulin was estimated as early as possible after separating the serum.

Choice of method

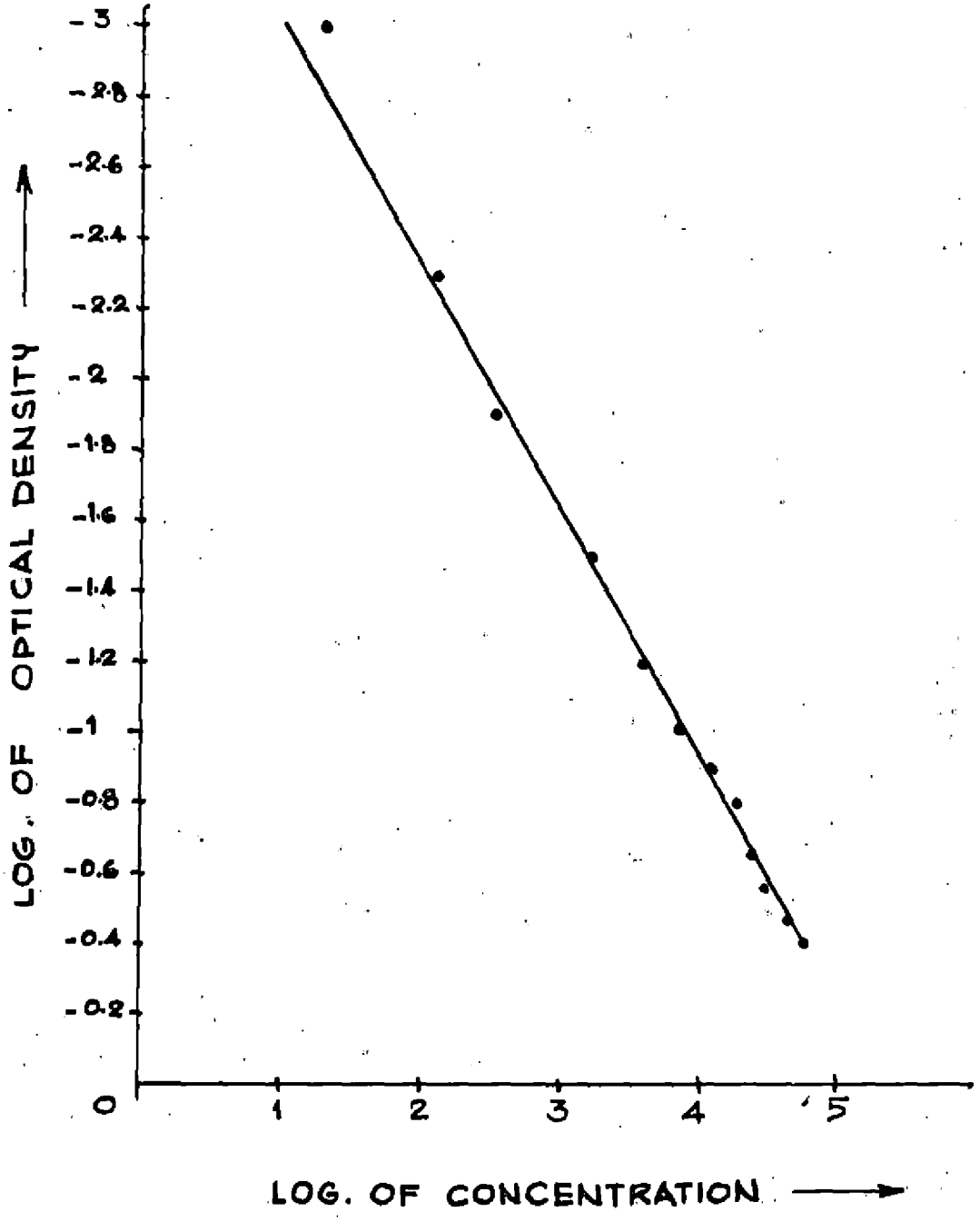
Zinc sulphate turbidity test has the advantage of being simple. Simultaneous handling of many samples could be done in relatively shorter time. Mc Beath et al. (1971) reported a high correlation (r = 0.99) between the results obtained by zinc sulphate turbidity test and single radial diffusion test. This result indicates that zinc sulphate turbidity test is accurate and reliable besides being simple, cheaper and fast. Fisher and Martinez (1976) could find that the correlation between added serum Ig level and zinc sulphate turbidity test reading was almost perfect.

Zinc sulphate turbidity test procedure

Zinc sulphate turbidity test procedure as described by Mc Ewan et al. (1970) was followed with suitable modifications. A working solution of zinc sulphate was prepared by diluting 4.1 ml of 5 per cent solution of zinc sulphate ($ZnSO_4 \cdot 7H_2O$) to one litre of freshly boiled and cooled double distilled water to give a final concentration of about 205 mg of zinc sulphate per litre of water.

Test tubes were arranged in three rows on the rack. The number of tubes in each row depended on the number of samples to be tested. For convenience of description, the first two rows of tubes may be called 'test tubes' and the third row of tube as 'control tube'. Six ml of the working solution of zinc sulphate was poured in each of the test tubes and a similar volume of distilled water in the control tubes using pipettes. Using a precision pipette 0.1 ml of each serum sample diluted to 1 in 4 with distilled water was poured into each of the tubes in a single column with a label corresponding to the serum. The tubes were shaken gently and allowed to stand at room temperature for an hour. The turbidity developed in each tube was read in a spectrocolorimeter (Spectronic 20) at a wave length of 595 nm. The adjustment was made

● FIGURE 3.1



STANDARD CURVE FOR SERUM IMMUNOGLOBULIN LEVELS

against zinc sulphate solution. The tubes were shaken for redistribution of precipitate. The reading of control was subtracted from the average readings of the test solutions to arrive at the optical density (O.D) of each individual serum samples. The O.D. values were converted into gammaglobulin concentration (mg/ml) of serum with the help of prediction equation developed from standard curve (Fig.3.1).

Preparation of standard curve for sera

Commercial bovine gammaglobulin (Sigma chemical Co., St. Louis, U.S.A.) were dissolved in pooled pre-colostral kid sera, to give concentration ranging from 4 to 120 mg/ml. The pre-colostral serum after dissolving the gamma-globulin was diluted to 1 in 4 with distilled water. Pre-colostral kid serum was used for the preparation of standard solutions as it contained negligible amounts of gammaglobulin to start with. The standard solutions were then subjected to zinc sulphate turbidity test. To arrive at the net O.D. values, the value obtained for the control were subtracted from the average of observed value of the test solutions. The net O.D. obtained are presented in the table 3.1. which are the averages of 3 replications.

Table 3.1. Average O.D. values obtained for different strengths of added gammaglobulin.

Strength in mg/ml	Average O.D. value
120	0.668
108	0.633
96	0.575
84	0.523
72	0.450
60	0.405
48	0.347
36	0.297
24	0.223
12	0.150
8	0.100
4	0.050
0	0.000

The log linear prediction equation was prepared which could be used to interpret any O.D. value.

Prediction equation:

$$y = 5.3014+1.3709X$$

where, y = logarithm of predicted gammaglobulin level in unknown serum.

X = logarithm of optical density value of the serum.

The antilogarithm of y was found to measure the gammaglobulin level in mg/ml in the unknown serum. The coefficient of correlation between actual and predicted values of concentration was 0.9962. Logarithmic transformation was necessary to avoid bias at lower values of optical density.

3.1. Estimation of the pre-colostral serum Ig level in neonatal kids.

Blood was collected from five male kids immediately after birth before feeding colostrum. The gammaglobulin levels in the sera were estimated and the mean value was tabulated.

3.2. Estimation of the post-colostral serum Ig level in neonatal kids.

3.2.1. To locate the post colostral peak of serum Ig level in kids.

Five neonatal male kids were bled from birth upto 24 hours at bihourly intervals. The Ig level in their

sera were estimated. The mean time at which post-colostral peaks were reached was estimated.

3.2.2. Assessment of the trend in post colostral serum Ig level from birth to 24 hours and assessment of magnitude of post colostral peak level.

The trend in Ig level in the sera of five neonatal kids, from birth to 24 hours were estimated at bihourly intervals. The mean values at different time intervals were tabulated. The variation between animals and within animals at different times were analysed using randomised block design. The statistical model used was:

$$y_{ijk} = \mu + b_i + t_j + e_{ijk}$$

where, μ = general mean

b_i = effect due to i^{th} period,

t_j = effect due to j^{th} animal and

e_{ijk} = error associated with k^{th} sample at i^{th} period of j^{th} animal.

The mean post colostral peak level of serum Ig was determined by estimating the Ig level in the sera of 51 male kids at 17.36 hours.

3.3. Trend in serum Ig level from birth upto 8 weeks of age.

Blood samples were collected from 10 male kids on alternate days from birth to one week of age and on weekly intervals thereafter upto 8 weeks of age. The serum Ig levels were estimated and the mean value of the kids at each period was calculated. The variation between kid and within kid at different periods were analysed using randomised block design. The statistical model used was:

$$y_{ijk} = \mu + b_i + t_j + e_{ijk},$$

where, μ = general mean,

b_i = effect due to i^{th} period

t_j = effect of j^{th} animal,

e_{ijk} = error associated with k^{th} sample of i^{th} period of j^{th} animal.

3.4. Factors affecting post colostral peak level.

3.4.1. Effect of genetic group

Three genetic groups were considered for the study, namely Saanen x Malabari (SM), Saanen x Saanen Malabari (SSM), Saanen x Alpine Malabari (SAM). There were 20 SM, 13 SSM and 12 SAM kids and the breed wise means tabulated. The effect of genetic group on post colostral peak level of Ig, was analysed using completely randomised design.

The statistical model used was:

$$Ig\ (ij) = \mu + b_i + e_{ij}$$

where, μ = general mean,

b_i = effect due to i^{th} breed and

e_{ij} = error associated with j^{th} animal in i^{th} breed.

3.4.2. Effect of type of birth

Blood was collected from 12 single kids 31 twins and 8 triplets at post colostral peak. The Ig levels were estimated and the mean values for each group was tabulated. The effect of type of birth on post colostral peak of serum Ig was analysed using completely randomised design. The statistical model used was:

$$Ig\ (ij) = \mu + b_i + e_{ij}$$

where, μ = general mean,

b_i = effect due to i^{th} type of birth and

e_{ij} = error associated with j^{th} animal in the type of birth.

3.4.3. Effect of birth weight

The correlation between birth weight of 51 male kids and their post colostral peak level of serum Ig was worked out.

3.5. Association of post colostral peak of serum Ig level with neonatal kid motality.

Serum Ig levels were estimated in 51 male kids at post colostral peak. The mean level was then calculated. The kids were then observed for two months for studying the mortality rate. The mean post colostral peak of kids, died within two months was compared with that of survivors by using 'students' t' test.

The mortality rate of kids above the mean level and below the mean level were tabulated separately.

3.6. Effect of serum Ig level on body weight.

3.6.1. Post colostral peak level of serum Ig x weight gain at 56 days after birth

Post colostral peak of serum Ig was estimated in 33 male kids. Body weight of these kids were recorded at 56 days. The correlation between the Ig level and body weight in these kids at 56 days were estimated.

3.6.2. Correlation between trends in serum Ig levels and body weight upto 8 weeks of age of kids.

Serum Ig levels were estimated in ten male kids from birth at weekly intervals to eight weeks of age. Their body weights during the corresponding periods were also recorded. The correlation between Ig level and body weights during the corresponding period was estimated.

RESULTS

RESULTS

4.1. Pre-colostral Ig levels

The Ig level in neonatal kid sera before feeding colostrum ranged between zero and 0.940 mg/ml. The precolostral gammaglobulin level in kids is given in the table 4.1.

Table 4.1. Pre-colostral Ig level in kids.

Sl. No.	1	2	3	4	5
Kid No.	3252	F2S 107	925	SAM 8	SAM 9
Ig level (mg/ml)	0.140	0.000	0.940	0.634	0.364

The mean pre colostral Ig level in kid serum was found to be 0.415±0.169 mg/ml.

4.2. Post colostral serum Ig level

4.2.1. Time of attainment of post colostral peak

The post colostral peak was observed at 18th hour in four kids and 16th hour in one kid. The mean time was 17.36 hours.

4.2.2. Trend in serum Ig level from birth to 24 hours and magnitude of post colostral peak

The mean pre-colostral serum Ig level went on increasing until it reached a peak level at 16-18 hours. At 18 hours the mean Ig level was 84.85±7.952 mg/ml. Then it began to decline gradually reaching a mean level of 67.766±5.196 mg/ml at 24 hours. The bihourly trend in serum immunoglobulin from birth to 24 hours is given in the table 4.2.

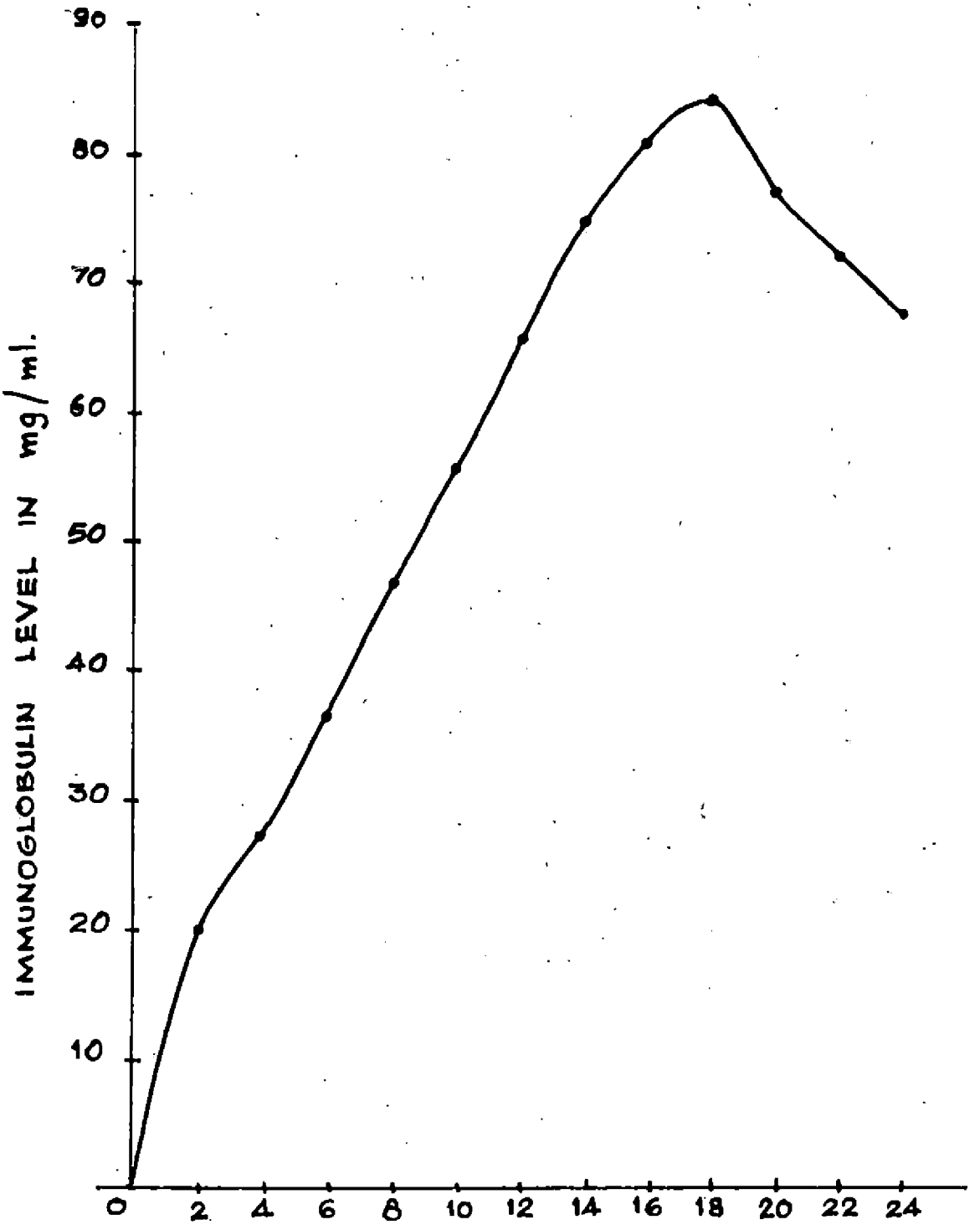
The trend is graphically represented in figure 4.1. The raw data is given in the appendix a.

Analysis of variance (table 4.3.) showed that there were significant ($P < 0.01$) difference in the Ig level between animals and within animals during different intervals.

Table 4.3. Analysis of variance for partitioning the effect of periods and animals.

Source of variation	degrees of freedom	sum of squares	Mean sum of squares	F value
Periods	12	42149.9529	3572.4959	36.91**
Animals	4	6484.4558	1621.1139	17.03**
Error	48	4568.3567	95.1714	
Total	64	53202.7627		

** Significant at 1% level.



● FIGURE 4.1

TREND IN SERUM IMMUNOGLOBULIN LEVELS FROM BIRTH TO TWENTY FOUR HOURS.

Table 4.2. Trend in bihourly Ig levels from birth to 24 hours

Time in hours	0	2	4	6	8	10	12	14	16	18	20	22	24
Mean immunoglobulin level (mg/ml)	0.4156 ± 0.169	20.505 ± 3.802	26.9784 ± 4.912	36.4756 ± 3.942	46.7954 ± 6.677	55.5003 ± 5.625	65.7032 ± 5.82	74.6538 ± 9.364	81.3242 ± 10.282	84.852 ± 7.952	77.2634 ± 6.836	72.9514 ± 1.891	67.766 ± 5.196

The F value for periods and animals were significant ($P < 0.01$). The mean post colostral peak level of serum Ig was 73.5881±2.2035 mg/ml. It ranged between 42.975 and 107.646 mg/ml. The raw data is presented in the appendix b.

4.3. Trend in serum Ig level from birth to 8 weeks of age.

The Ig level in the first day kid serum ranged from 0.940 mg/ml to 66.117 mg/ml. The mean Ig during different periods are summarised in Table 4.4.

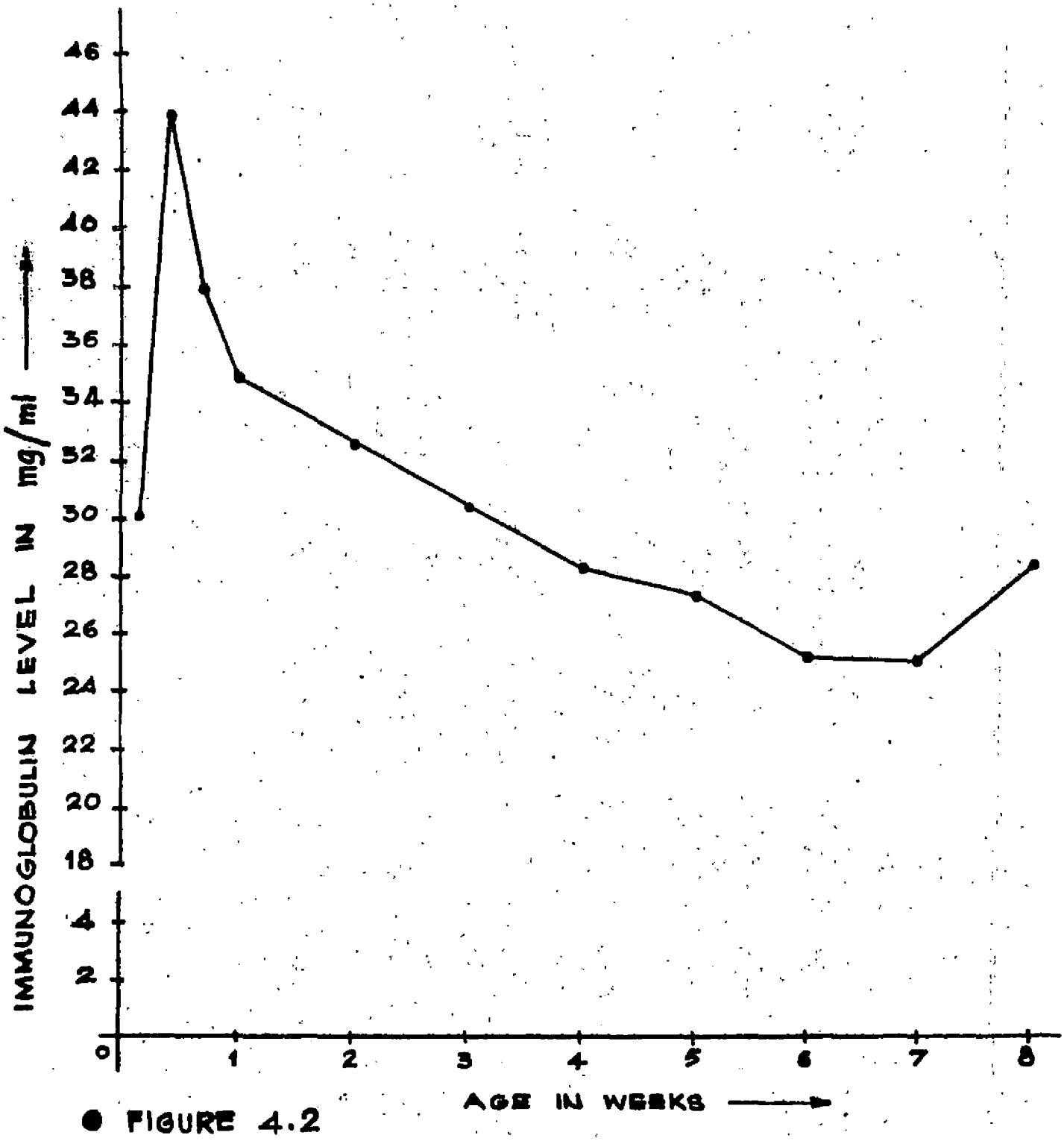
The raw data is presented in the appendix c. The trend in serum immunoglobulin level is graphically shown in fig. 4.2.

The analysis of variance (table 4.5) for the effect of periods and the difference between the individual animals showed that both factors had significant effect on trend in serum gammaglobulin level ($P < 0.01$).

Table 4.5. Analysis of variance for partitioning the effect of periods and animals.

Source of variation	Degree of freedom	sum of squares	mean sum of squares	F value
Different periods	10	3294.2599	329.4260	3.999**
Between animals	9	2375.0495	263.8944	3.2042**
Error	90	7412.2066	82.3578	
Total	109	13081.5158		

** Significant at 1% level.



● FIGURE 4.2

TREND IN SERUM IMMUNOGLOBULIN LEVELS FROM BIRTH TO EIGHT WEEKS

Table 4.4. Trend in serum immunoglobulin level from birth to 8 weeks of life in kids.

Age of the kid	1st day	3rd day	5th day	7th day	IInd week	IIIrd week	IVth week	Vth week	VIth week	VIIth week	VIIIth week
Mean immunoglobulin level (mg/ml)	30.7514 ± 7.5981	44.3318 ± 6.5625	37.6298 ± 4.1521	35.1763 ± 2.6699	32.7686 ± 2.4139	30.4976 ± 2.1236	28.5833 ± 2.6805	27.3355 ± 1.4952	25.3297 ± 1.7428	25.3773 ± 1.7485	28.6085 ± 1.9113

4.4. Factors affecting post colostral peak level of serum Ig

4.4.1. Effect of genetic group

Mean serum Ig levels of the three genetic groups considered for study are given in table 4.6.

Table 4.6. Mean Ig levels of three breeds

Genetic group	Saanen Malabari (SM)	Saanenx Saanen Malabari (SSM)	Saanen x Alpino Malabari (SAM)
Mean post colostral peak level of serum immunoglobulin (mg/ml)	76.9399 ± 5.800	60.0569 ± 3.603	69.7820 ± 4.1815

The raw data are given in the appendix b.

The analysis of variance revealed that the effect of genetic group on post colostral peak of serum Ig levels was significant ($P < 0.05$). The analysis of variance is given in table 4.7.

Table 4.7. Analysis of variance for studying the effect of breed on serum Ig level.

Source of variation	degrees of freedom	sum of squares	mean sum of squares	F value
Genetic group	2	2247.9983	1123.9991	3.8302*
Error	42	12325.1109	293.4550	
Total	44	14573.1092		

* Significant at 5% level.

Pair-wise comparison taking the critical difference for each pair showed no statistically significant difference between pairs.

4.4.2. Effect of type of birth

The mean post colostral peak level of serum Ig in single kids was 78.014±5.1344 mg/ml. Twins had a mean post colostral peak immunoglobulin level of 75.0097± 3.014 mg/ml, whereas triplets had only 61.4406±3.7968 mg/ml. The raw data is presented in the appendix b.

The analysis of variance (table 4.8) showed no statistically significant difference between the types of birth.

Table 4.3. Analysis of variance for studying the effect of type of birth in serum Ig level

Source of variation	degrees of freedom	sum of squares	mean sum of squares	F value
Type of birth	2	1478.2053	739.1027	2.7839N.S
Error	48	12743.5821	265.4913	
Total	50	14221.7874		

N.S Not significant

4.4.3. Effect of birth weight

A positive correlation of 0.2620 was found between birth weight and post-colostral peak level of serum Ig. But this was not found to be statistically significant. The raw data is presented in appendix b.

4.5. Association of post colostral peak of serum Ig level in kids with neonatal mortality.

Mean peak level of serum Ig in the population consisting of 51 kids was 73.5881±2.2035 mg/ml. Among the 51 kids, 12 kids died within a period of 2 months. The mean post colostral peak level of the dead kids was 56.771 mg/ml. The results of the 'students' t test indicated that there were significant differences between

the post colostral peak level of dead kids and live kids.

t = 4.9319** ** Significant at 1% level.

Dead kids had significantly lower level of serum Ig. Kids were divided into two groups based on their Ig level, and the percentage of mortality in each group was noted. Table 4.9 represents the mortality rate in kids with two levels of immunoglobulin. Raw data is given in the appendix b.

Table 4.9. Effect of serum Ig level on mortality of kids.

Group number	Ig level	Total no. of kids.	No.of kids dead	Percentage of mortality
I	40-70 mg/ml	25	11	44.000
II	above 70 mg/ml	26	1	3.845

4.6. Effect of serum Ig level on body weight

4.6.1. Post colostral peak of serum Ig x body weight at 56 days

A negative correlation of -0.1548 was found between post colostral peak of serum Ig level and body weight

at 56 days. This was not found to be significant statistically. The raw data is shown in appendix b.

4.6.2. Correlation between weekly trend in serum Ig level body weight.

A positive correlation of 0.6933 was found between weekly trend in serum Ig level and weekly body weights. This was found to be statistically significant ($P < 0.05$).

DISCUSSION

DISCUSSION

5.1. Pre colostral serum Ig level in kids

The pre colostral serum Ig level in neonatal kids ranged from zero to 0.940 mg/ml with a mean value of 0.4156±0.169 mg/ml. Earlier workers like Aguilera (1971) and Bush et al.(1971) reported a pre-colostral serum Ig level of 2.9 mg/ml in calves, whereas Hunter et al.(1977) could find only 0.07 mg/ml in pre-colostral lamb sera. The present observation does not depart much from these values. This clearly indicates that pre-colostral sera of neonatal ruminants including kids contain only very small quantities of Ig. This might be due to the poor transplacental transfer of Ig. The small amounts of Ig present in the serum might have been synthesised by the foetus, since specific antibodies could not be detected in the pre-colostral sera of kids born to dams immunised to specific antigens (Famulener, 1912; Reyman, 1920 and Neubauer and Schone, 1979).

5.2. Post colostral serum Ig levels in kids.

5.2.1. Time of attainment of post-colostral peak

The post colostral peak was attained in a mean time of 17.36 hours in kids. Reyman (1920) could find that maximum titres of certain antibodies were reached in

11 hours in kids. Halliday et al. (1978) reported that serum IgG1 levels in calves reached a plateau at 13-14 hours. After studying the insulin binding antibody titres at 8 hourly intervals in kids, Neubauer and Schone (1979) found that pre-colostral peak was reached before 24 hours. The present findings does not depart much from these findings.

5.2.2. Trend in serum Ig level from birth to 24 hours, and magnitude of post-colostral peak

The Ig level rose rapidly in the kid sera after suckling. After reaching the peak level, that began to fall gradually (table 4.2). This finding agrees with the findings of Halliday (1978) and Clover and Zarkower (1980).

The post-colostral peak level of Ig in kids were observed to range between 42.975 and 107.646 mg/ml with a mean value of 73.5881±2.2035 mg/ml. The values reported for calves were comparatively lower (Aguilera, 1971; Bush et al.1971; Clover and Zarkower, 1980). The reported level for lambs were also lower (Hunter et al. 1977). Reyman (1920) suggested that the antibody titre of kid serum may reach the titre of colostrum and the values for colostral Ig levels in goats were about 65 mg/ml (Askonas, 1956) and in ewes it may be as high as 115.1±10.1 mg/ml (Hunter et al.1977). The higher level of serum Ig in

kid compared to calves and lambs might be due to herd or species variation.

5.3. Trend in serum Ig levels from birth to eight weeks of age.

Ig level in the first day serum varied according to the time of collection of blood. Serum samples of kids, collected near the post-colostral peak had the highest Ig level during the eight weeks' period studied. This agrees with the findings of Logan et al.(1974). However, the mean serum Ig level was highest on the third day because serum was collected only on alternate days. This agrees with the findings of Tennant et al.(1969) in calves, who found highest Ig level in calves aged 1-5 days. The Ig level in kid sera gradually began to decline until about 6-7 weeks of age. This finding is supported by findings of Tennant et al. (1969) and Logan et al.(1974). By about 6-8 weeks the serum Ig level again began to rise. This could be due to the autogenous production of antibodies. This finding is supported by the findings of Tennant et al.(1969)

5.4. Factors affecting post colostral peak of serum Ig level

5.4.1. Effect of genetic group

The effect of genetic group on post-colostral peak

of serum Ig levels was found to be significant ($P < 0.05$). Saanen - Malabari (SM) kids had the highest mean serum Ig level, followed by Saanen x Alpine-Malabari (SAM). The least mean serum Ig level was seen in Saanen x Saanen-Malabari (SSM). Such breed differences have been recorded earlier in lambs (Halliday, 1968) and in calves (Tennant et al. 1969).

The difference in Ig levels in different genetic groups might be due to the genetic variation in the ability of kids to absorb Ig or due to the environmental factors as the difference in adaptability and vigour of the various groups to ingest sufficient amounts of colostrum. However, it seems that the increased level of exotic inheritance reduces post-colostral peak level of serum Ig in kids.

5.4.2. Effect of type of birth.

Mean serum Ig level was the highest in single kids, followed by twins and the least in triplets. However, the difference was not statistically significant. Logan and Irwin (1977) had also found in lambs that singles had the highest mean serum Ig levels followed by twins and triplets. The difference in Ig level could be due

to the increased vigour and thriftness of singles over triplets and to some extent over twins.

5.4.3. Effect of birth weight

A positive correlation of 0.262 was found between birth weight and post-colostral peak level of serum Ig. However, this was not statistically significant. At one hour after feeding colostrum, Halliday and Williams (1979) found a negative correlation between the two traits in lambs

The heavier kids are usually more healthy and thrifty as compared to lighter kids. This could be the reason for the positive correlation between the traits.

5.5. Association of post-colostral peak level of serum Ig in kids with neonatal mortality.

The Ig level in dead kids were significantly lower than that of the healthy surviving kids. Mortality rate was higher in kids with Ig level below the population mean (Table 4.9). Similar observations have been recorded by Thomas and Swaan (1973) Campbell (1974) and Irwin (1974).

Higher Ig levels might have protected neonatal kids from infection and subsequent death. The survival of kids with low Ig levels could be due to the high titres

of specific antibodies against common pathogens, in their serum. Conversely, death of kids with high serum Ig level could be due to the deficiency of specific antibodies against common pathogens or a rapid depletion of serum Ig pool as described by Fisher et al.(1976).

5.6. Effect of Ig levels on body weight.

5.6.1. Effect of post-colostral peak of serum Ig on gain in body weight at 56 days.

A negative correlation of -0.1548, which was not statistically significant was obtained between the two traits. A similar finding has been recorded by Cuipercescu (1977). Higher post-colostral peak levels of serum Ig might have delayed the antogenous production of antibodies (Logan et al.1974).

5.6.2. Correlation between weekly trend in serum Ig level and body weight.

There was a significant ($P < 0.05$) positive correlation of 0.6933 between the two traits. This finding is supported by the findings of Halliday (1976) and Halliday et al. (1978) in lambs.

Persistantly higher levels of Ig might have protected the kids from neonatal infections providing better growth rate.

In the light of these findings some recommendations may be made which would be useful to reduce

infections, mortality and poor performance in kids.

It would be better to provide the neonatal kid with colostrum ad libitum within first two hours after birth (since maximum rate of absorption was seen within two hours after feeding colostrum immediately after birth). Delay in the feeding of colostrum may lead to hypogammaglobulinaemia in kids. This may predispose the kid to infections and subsequent death. The rise in serum Ig level by 7 to 8 weeks can be due to the increased autogenous production of antibodies. So it would be better to begin any active immunisation programme in kids only after an age of 7-8 weeks to get a better response. The significant variation in serum Ig level in different genetic groups may be a contributory factor in determining the infections and death among the groups. An increase in the level of exotic inheritance seem to reduce the post colostral peak level of serum Ig. Since triplets tend to have low serum Ig level special attention should be given in feeding colostrum to them. Wherever possible the colostrum of contemporaneously kidded dams can be used for feeding the triplet kids and for the feeding of orphan kids. The heavy mortality rate in kid, with low serum Ig level calls for a screening for serum Ig level in neonatal kids at the

post colostral peak. The hypogammaglobulinaemic kids may be provided with very strict hygienic conditions. Oral or parenteral administration of gammaglobulin preparations or hyper immune serum against common pathogens can be tried in these kids to reduce mortality rates. Colostrum may be fed even after closure which may provide some immunity against enteropathogens. Similar procedures may be tried in neonatal kids with stunted growth.

SUMMARY

SUMMARY

The Immunoglobulin (Ig) level in the sera of male kids in neonatal stage was studied in different genetic groups of goats maintained at A.I.C.R.P. on goats for milk production, Mannuthy, during the period from 3.7.1980 to 6.2.1981 using Zinc sulphate turbidity test.

The pre-colostral serum Ig level in male kids ranged from zero to 0.940 mg/ml with a mean of 0.4156±0.169 mg/ml. This level increased rapidly following the ingestion of colostrum, till it reached a peak after 16-18 hours (mean 17.36 hours). The serum Ig level at the peak was found to range from 42.975-107.467 mg/ml with a mean of 73.5881±2.3035 mg/ml. The serum Ig level after reaching the peak showed a declining trend upto about 6-7 weeks, whereafter it started rising again. Significant individual variation was discernable during the period.

There was significant difference ($P < 0.05$) between genetic groups in the post-colostral peak of serum Ig level, with Saanen x Malabari showing the highest level. Though singlets had higher serum Ig level than twins and twins had higher serum Ig levels than triplets, the effect of type of birth on the post colostral peak of

serum Ig level was found to be statistically not significant. A positive correlation (0.2620) was observed between birth weight and post colostral peak of serum Ig level in kids, though not statistically significant.

The post colostral peak of serum Ig level in kids died within two months was significantly ($P < 0.01$) lower (56.771 mg/ml) than the population mean (73.5681 mg/ml). The rate of kid mortality was found to be higher (44%) among kids with the peak serum Ig level ranging from 40-70 mg/ml, whereas in kids with peak level above 70 mg/ml the mortality rate was only 3.845 per cent.

The correlation between post colostral peak and gain in body weight upto 56 days was found to be negative but statistically not significant. There was significant ($P < 0.05$) positive correlation between weekly serum Ig level and weekly body weight in kids.

The results of the present study indicate that colostrum should be made available to kids as early after birth as possible preferably within two hours. The hypogammaglobulinaemic kids should be provided with special care considering the heavy mortality rate in them. The study also suggested that autogenous production of Ig is noticeably higher after seven weeks of age.

REFERENCES

REFERENCES

*Aguilera, M. (1971). Absorption of colostral immunoglobulin by the new born calf. Revista de la Facultad de Medicina Veterinaria. Y. Zootechnia. 3 (1): 1-14. Dairy Sci. Abstr. (1973). 35(4): 1324.

Asherson, G. (1976). An introduction to immunology in "The cell in medical sciences" (Beck, F. and Lloyd J. Ed.) Academic Press, New York and London. Vol. 4. pp.57-222.

Askonas, B.A. Campbell, P.N., Humphrey, J.H., and Work, T.S. (1956). The source of antibody in rabbit milk and goat colostrum. Biochem. J. 56: 597-601.

*Balberz, H. (1976). Immunological phenomena of calves during neonatal period, Veterinaryna 32(5): 259-264. (Dairy Sci. Abstr. (1976) 38: 339).

*Balfour, W.E. and Comline, R.S. (1959). The specificity of intestinal absorption of large molecules by the new born calf. J. Physiol. 148: 77-78.

Balfour, W.E. and Comline, R.S. (1962). Acceleration of the absorption of unchanged globulin in the new born calf by factors in colostrum. J. Physiol. 160: 234-257.

Barber, D.M.L. (1979). Control of diarrhoea and death in homebred dairy calves by bucket feeding of pooled colostrum. Vet. Rec. 104(17): 385-386.

Bhatia, K.L. and Ganguli, N.C. (1977). Post partum changes in immunoglobulin level in milk of Zebu and cross bred cows. Indian J. Dairy Sci. 30(1): 82-84.

Boyd, J.W. (1972). The relationship between serum immunoglobulin deficiency and diseases in calves. A Farm Survey. Vet. Rec. 90(23): 645-649.

Brandon, M.R. Watson, D.L., and Lascelles, A.K. (1971). Relative efficiency of absorption of IgG1, IgG2, IgA and IgM in the new born calf. Aust. J. Exp. Biol. Med. Sci. 49: 629-633.

Brambel, F.W.R. (1970). The transmission of passive immunity from mother to young. North Holland Publishing Company, Amsterdam, London, pp.201-223.

Bringole, T.J. and Stott, G.H. (1979). Colostrum feeding after closure, a protection for agamma and hypogamma globulinaemic calves. J.Dairy Sci.62:93-96.

Bringole, T.J. and Stott, G.H. (1980). Effect of suckling followed by bottle feeding colostrum on immunoglobulin absorption and calf survival. J. Dairy Sci. 63(3): 451-457.

Bush, L.T., Aguilera, M. Adams, G.D., and Jones, E.N. (1971). Absorption of colostral immunoglobulins by new born dairy calves. J. Dairy Sci. 54(10): 1547-1552.

Butler, J.E. (1969). Bovine immunoglobulins. A review. J. Dairy Sci. 52(12): 1895-1909.

Butler, J.E. (1973). Synthesis and distribution of immunoglobulins. J. Amer. Vet.Med.Ass. 163(7):795-798.

Campbell, S.G.(1974). Experimental colostrum deprivation in lambs. Br. Vet. J. 30: 538-540.

Castro, A. Dhindsa, D.S., Hoverland, A.S. and Metcalfe,J. (1977). Serum proteins and protein electrophoretic pattern in normal Pygmy goats. Am. J. Vet. Res. 38(5): 665-668.

Clover, C.K. and Zarkower, A.(1980). Immunologic responses of colostrum fed and colostrum deprived calves. Am. J. Vet. Res. 41(7): 1002-1008.

Ciupercescu, D.D. (1977). Dynamics of serum immunoglobulin concentration in sheep during pregnancy and lactation. Res. Vet. Sci. 22: 23-27.

Desiderio, J.V., Turillo, A.L., and Campbell, S.G. (1979). Serum proteins of normal goats and goats with caseous lymphadenitis. Am. J.Vet. Res. 40(3) 400-403.

Ducker, M.J. and Fraser, J.(1976). A note on the effect of uptake of colostrum on blood gammaglobulin levels, mortality and subsequent performance of housed calves. Anim. Prod. 20(3): 411-414.

* Ermekov, M.A. Ten, V.M., Sadikov, T.S. and Nurmagambetov, D.N.(1973). Early ingestion of colostrum improves viability of the lamb. Ovtsevodstvo 8: 21-22 (Dairy Sci. Abstr. (1975). 37: 4272).

Eugester, A.K. and Storz, J. (1971). Effect of colostral antibodies on the pathogenesis of intestinal chlamydial infection in calves. Am. J. Vet.Res. 32(5): 711-718.

* Famulener, L.W.(1912). On the transmission of immunity from mother to offspring. A study upon serum haemolysins in goats. J. Infect. Dis. 10: 332-368. (cited from Brambel (1970) Transmission of passive immunity from mother to young. North Holland Publishing Company, Amsterdam, London.

* Feinstein, A., and Hobart, M.J. (1969). Structural relationship and complement fixing activity of sheep and other ruminant IgG subclasses. Nature (Lond.) 223 (5209): 950-952.

Findlay, C.R. (1973). Serum immunoglobulin levels in lambs under a week old. Vet. Rec. 92(20): 530-532.

Fisher, E.W. and DelaFeunte, G.H. (1971). Antibiotics and calf diarrhoea. The effect of serum immunoglobulin concentration. Vet. Rec. 89(22): 645-649.

Fisher, E.W. and Martinez, A.A. (1975). Correlation for haemolysis in zinc sulphate turbidity test. Vet. Rec. 96 (5): 113.

Fisher, E.W. and Martinez, A.A. (1976). Immunoglobulin and enteroxic colibacillosis. Vet.Rec. 98(2): 31.

Fisher, E.W., Martinez, A.A., Trainin, Z., and Mariom, R. (1976). Studies on neonatal calf diarrhoea. IV Serum and faecal immunoglobulin in neonatal salmonellosis. Br. Vet. J. 132: 39-49.

Gay, C.C., Fisher, E.W., and Mc Ewan, A.D. (1965). Gammaglobulin levels and neonatal mortality in market calves. Vet. Rec. 77: 148-149.

Halliday, R., (1965). The transfer of antibodies from Ewes to their lambs. J. Immunol. 95(3): 510-514

Halliday, R. (1968). Serum protein concentrations in 2 day-old Finnish Landrace, Scottish Blackface, Merino and Merino x Cheviot lambs. J. Agric. Sci. 71: 41-46.

Halliday, R. (1976). Variations in immunoglobulin concentrations Finnish x Dorset Horn lambs. Res. Vet. Sci. 21(3): 331-334.

Halliday, R., and Williams, M.R. (1976). Passive immunity in lambs. Effect of a second feed of colostrum on the antibody absorption from the first feed. Res. Vet. Sci. 21(2): 173-175.

*Halliday, R. and Williams, M.R. (1979). The absorption of immunoglobulin from colostrum by bottlefed lambs. Annales de Recherches Veterinaires (Vet. Bull. (1980): 50: 1008) 10(4): 549-556.

Halliday, R. and Williams, M.R. (1980). The relationship between serum immunoglobulin level and specific antibody production in calves. Res. Vet. Sci. 28(1): 76-81.

Halliday, R., Russel, A.J.F., Williams, M.R. and Peart, J.N. (1978). Effects of energy intakes during late pregnancy and genotype on immunoglobulin transfer in calves in suckler herds. Res. Vet. Sci. 24(1): 26-31.

*Hanson, R.D. and Phillipps, P.H. (1947). Studies on proteins from bovine colostrum. 1. Electrophoretic studies on blood serum proteins of colostrum free calves and of calves fed colostrum at various ages. J. Biol. Chem. 177: 223-227.

Hardy, R.N., (1969). The influence of specific chemical factors in the solvent on the absorption of macromolecular substance from the small intestine of new born calf. J. Physiol. 204: 607-632.

Hunter, A.G., Reneau, J.K. and Williams, J.B. (1977). Factors affecting IgG concentration in day old lambs. J. Anim. Sci. 45(5): 1146-1151.

Husband, A.J., Brandon, M.R. and Lascelles, A.K. (1972). Absorption and endogenous production of immunoglobulin in calves. Australian J. Exp. Biol. Med. Sci. 50(5): 491-498.

Husband, A.J. and Watson, D.L. (1978). Immunity in the intestine. Vet. Bull. 48(11): 911-924.

Irwin, V.C.R. (1974). Disease incidence in colostrum deprived calves under commercial conditions and the economic consequences. Vet. Rec. 94(18): 406-409

Jacobs, R.M., Valli, V.E.O. and Wilkie, B.N. (1980). Serum electrophoresis and immunoglobulin concentration in cows with lymphoma. Am.J.Vet.Res. 41 (12): 1942-47.

Jalnapurkar, B.V., Ajinkya, S.M. and Sardespande, P.D. (1976). Immunoglobulin G in the sera of new born buffaloe (Bos bubalis bubalis) calves. Vet. Rec. 99(8): 146.

Jalnapurkar, B.V., Ajinkya, S.M. and Sardeshpande, P.D. (1977). Immunoglobulin G in buffaloe foetal calf serum. Vet. Rec. 107(8): 154.

Jensen, (1893). cited from Logan E.F.(1974). Colostral immunity to colibacillosis in the neonatal life. Br. Vet. J. 130(5): 495.

*Klaus, C.G.B., Bennet, A. and Jones, E.W.(1969). A quantitative study of the transfer of colostral immunoglobulins to the new born calf. Immunology. 16: 293-299.

Kruse, V.(1970). Absorption of immunoglobulin from colostrum in new born calves. Anim. Prod. 12: 627-638.

Larson, B.C. and Kendall, K.A. (1957). Protein production in the bovine. Daily production of specific milk proteins during the lactation period. J. Dairy Sci. 40: 377-386.

Logan, E.F. and Penhale, W.J. (1971). Studies on the immunity of calves to colibacillosis. 1. influence of colostral whey and immunoglobulin factors on experimental coli septicaemia. Vet.Rec. 88(9):222-28.

Logan, E.F. and Irwin, D.(1977). Serum immunoglobulin levels in neonatal lambs. Res.Vet. Sci.23(3): 389-390.

Logan, E.F., Mc Beath, D.G. and Lowman, B.G.(1974). Quantitative studies on serum immunoglobulin levels in suckled calves from birth to five weeks. Vet. Rec. 94(16): 367-370.

Manomohan, C.B., Ramachandran, K.N., Valsala, K.V. and Lalitha Kunjamma, C.R. (1979). Incidence of kid mortality in Kerala. Kerala J. Vet. Sci. 10(2): 312-317.

Mc Beath, D.G., Penhale, W.J., and Logan, E.F. (1971). An examination of the influence of husbandry on the plasma Ig level of the new born calf using a rapid refractometric test. Vet. Rec. 88(8): 266-270.

Mc Ewan, A.D., Fisher, E.W., Selman, I.E. and Penhale, W.J. (1970). A turbidity test for the estimationo of immunoglobulin levels in neonatal calf serum. Clin. Chim. Acta 27: 155-163.

Mc Guire, T.C., Pfieffer N.E., Weikal, J.M. and Bartsh, R.C. (1976). Failure of colostral immunoglobulin transfer in calves dying of infectious deseases. J. Am. Vet. Med. Ass. 169(7): 713-718.

Mc Nulty, M.S., Mc Ferron, J.B., Brison, O.G., Logan, E.F., and Curran, W.L. (1976). Studies on Rotavirus infection and diarrhoea in calves. Vet. Rec. 99(12): 229-230.

Merriman, M.J.G.S. (1971). Serum immunoglobulin in new born calves before and after colostrum feeding. Can. J. Comp. Med. 35(4): 269-273.

*Micusan, V.V., and Borduas, A.G. (1977). Biological properties of goat immunoglobulin G. Immunology. 32 (4): 373-381.

Nair, T.S., Balakrishnan, C.R. and Raja, C.A.R. (1979). Effect of parturition on serum immunoglobulin level in goats. Kerala J. Vet. Sci. 10(2): 309-312.

Neubauer, H.P. and Schone, H.A. (1979). Transfer of insulin binding antibodies from nanny goats to kids. Am. J. Vet. Res. 40(7): 962-966.

Osburn, B.I. (1973). Immuno responseness of the foetus and neonate. J. Am. Vet. Med. Ass. 163(7): 801-803.

Osburn, B.I. Stabefeldt, G.H., Ardans, A.A., Trees, C. and Sawyer, N.S. (1974). Perinatal immunity in calves. J. Am. Vet. Med. Ass. 164: 295-98.

*Pahud, J.J. and Mach, J.P. (1970). Identification of secretory IgA, free secretary piece and serum IgA in ovine and caprine species. Immunochemistry. 15: 679-686. (Vet. Bull.(1971): 41: 763).

Park, B.H. and Good, R.A. (1974). Principles of modern immunobiology, Lea and Febiger, Philadelphia.pp.10-196.

Penhale, W.J., and Christie, G.(1969). Quantitative studies on bovine immunoglobulin. 1. Adult plasma and colostrum levels. Res. Vet. Sci. 10(6): 493-501.

*Pierce, A.E. (1955). Electrophoretic and immunologic studies on sera from calves from birth to weaning with special reference to normal and induced agglutinins to Trichomas foetus. J. Hyg. 53: 261-275.

*Pierce, A.E.(1961). Further studies on protenuria in the new born calf. J. Physiol. 156: 136-149.

Ranetunga, P.(1971). Kid mortality in two major government farm in Ceylon. Trop. Anim.Hlth.Prod. 3: 52-61.

Reid,J.F.S. (1972). Serum immunoglobulin concentration in new born hill lambs. Vet. Rec. 90(13): 371-72.

Reyman, G.C.(1920). On the transfer of the so called normal antibodies from mother to offspring. 1. Agglutinins. J. Immunol. 5: 227-238. (cited from Brambel (1970). The transmission of passive immunity from mother to young. North Holland Publishing Company, Amsterdam).

Ross, J.G., Armour, J. and Lee, R.P. (1960). Further observation on the influence of genetical factors in resistance to helminthiasis in Nigerian Zebu. Vet. Rec. 72(7): 119-122.

Sawyer, M., Willadsen, C.H., Osburn, B.I., Mc Guire, T.C. (1977). Passive transfer of colostral immunoglobulin from ewe to lamb and its influence on neonatal lamb mortality. J. Am. Vet. Med. Ass. 171(12): 1255-1259.

Schultz, R.D.(1973). Comment on immune response of foetus and neonate. J. Am.Vet. Med.Ass. 167: 804-805.

Shubber, A.H., Doxey, P.L., Black, W.J.M. and Fitmoz, J. (1979). Immunoglobulin level in ewe colostrum and lamb serum. Res. Vet. Sci. 27(3): 283-297.

* Smith, E.L. and Holmes, A. (1948). The transfer of immunity to the new born from colostrum. J. Biol. Chem. 175: 349-57.

Stott, G.H., and Menefee, B.E. (1978). Selective absorption of the immunoglobulin IgM in the new born calf. J. Dairy Sci. 61(4): 461-467.

Tennant, B., Herrold, D., Reina-Guerra, M. and Laben, R.C. (1969). Neonatal alterations in serum gammaglobulin levels of Jersey and Holstein Friesian calves. Am. J. Vet. Res. 30: 345-354.

Thomas, L.H., and Swaen, R.G. (1973). Influence of colostrum on the incidence of calf pneumonia. Vet. Rec. 92(17): 454-455.

Yaguchi, H. (1979). Studies on the relationship between the serum gammaglobulin levels of neonatal piglets and their mortality or growth during first two months of age. An evaluation of ammonium Sulphate turbidimetric method. (Doctor of Vet. Med. thesis abstr.). Jap. J. Vet. res. 27(1& 2): 36.

* Originals not consulted.

APPENDIX

Appendix a. Bihourly trend in serum immunoglobulin levels (mg/ml) from 0-24 hours in kids.

Time in hours	Kid No. 3252	Kid No. F2S 107	Kid No. 925	Kid No. SAM 8	Kid No. SAM 9
0	0.140	0	0.940	0.634	0.364
2	34.179	19.117	10.965	20.588	17.676
4	39.391	19.849	25.958	21.334	28.360
6	42.975	37.631	46.641	25.958	29.173
8	44.798	62.077	62.077	29.992	35.033
10	61.078	67.137	65.100	44.798	39.391
12	90.608	72.303	72.303	48.504	44.798
14	91.719	89.500	88.397	49.443	54.210
16	98.460	98.460	97.328	52.289	60.084
18	75.450	107.646	99.596	66.117	75.451
20	73.348	91.719	93.951	58.108	69.191
22	71.261	81.855	88.397	57.127	66.117
24	66.117	80.777	77.570	52.289	62.077

Appendix b. Post colostral peak level of serum immunoglobulins, body weights, genetic groups and mortality in kids.

Kid No.	Genetic group	Birth weight (in kg)	Ig level (mg/ml)	Dead(D)/ Live(L)	Body weight at 56 days (in kgs)
3252	M	2.0	98.460	L	4.0
F2S 107	SM	2.0	107.646	L	4.7
925	SM	2.5	99.596	L	4.5
926	SM	2.3	84.020	D	-
SAM 8	SAM	2.0	66.117	D	-
SAM 9	SAM	2.1	76.508	L	3.8
927	SM	2.5	63.681	D	-
F2A 30	AM	1.5	92.833	L	3.5
SAM 17	SAM	2.0	57.127	D	-
930	SM	2.0	103.025	L	-
931	SM	1.8	60.084	D	-
3262	M	1.4	79.804	L	3.0
SAM 19	SAM	2.0	104.175	L	5.3
932	SM	1.3	71.261	L	3.5
933	SM	1.3	72.303	L	3.0
935	SM	1.3	86.201	L	5.0
SAM 20	SAM	1.8	77.570	L	5.4
SAM 21	SAM	1.5	42.975	D	-
SSM 39	SSM	1.5	63.081	D	-
SAM 23	SAM	3.5	73.348	L	6.0
F2A 38	AM	3.0	104.175	L	-
SSM 43	SSM	1.3	69.191	D	-
SAM 25	SAM	2.0	67.137	D	-
SSM 48	SSM	1.2	49.443	D	-

Contd...

Appendix b contdd..

Kid No.	Genetic group	Birth weight (in kg)	Ig level (mg/ml)	Dead (D)/ Live(L)	Body weight at 56 days (in kgs)
••• SSM 46	SSM	1.3	65.100	L	4.5
••• SSM 47	SSM	1.3	48.071	L	4.2
• SSM 45	SSM	2.8	75.451	L	-
• SSM 49	SSM	1.7	61.078	L	5.1
• 943	SM	2.0	86.201	L	-
•• 941	SM	2.1	88.397	L	4.6
•• F2A 39	AM	2.0	86.201	L	5.5
•• 944	SM	1.9	61.078	L	4.0
•• 945	SM	1.5	61.678	L	4.8
•• SAM 29	SAM	1.7	63.081	L	4.7
•• 947	SM	1.6	65.100	L	3.6
•• SAM 32	SAM	1.0	56.150	D	-
•• SAM 31	SAM	1.1	53.247	L	4.0
•• SSM 52	SSM	2.3	68.162	L	4.9
•• 951	SM	2.0	79.704	L	4.0
•• 952	SM	2.0	90.608	L	4.0
•• 953	SM	1.8	52.289	D	-
•• SSM 54	SSM	2.7	52.289	L	5.1
•• SSM 55	SSM	2.5	84.020	L	6.2
•• 955	SM	2.5	90.608	L	-
•• 956	SM	1.5	97.328	L	4.2
• F2A 43	AM	3.0	77.570	L	6.1
•• SSM 56	SSM	1.2	63.081	L	6.0
•• SAM 35	SAM	3.0	81.855	L	8.6
•• SAM 34	SAM	2.5	61.078	L	-
•• SSM 58	SSM	2.5	69.191	L	6.0
• SSM 60	SSM	2.8	44.798	L	7.9

• singles
•• Twins
••• Triplets

Appendix c. Trend in serum Ig (mg/ml) in kids from birth to 8 weeks of age.

Age of kids.	Kid No. 3210	Kid No. 6783	Kid No. 6784	Kid No. 908	Kid No. 3221	Kid No. 3223	Kid No. 910	Kid No. 3233	Kid No. 3234	Kid No. 3237
Ist day	27.553	7.960	66.117	55.178	29.173	15.574	41.172	0.940	3.763	60.084
3rd day	29.173	66.117	49.443	44.798	42.071	46.641	45.717	35.894	35.894	47.570
5th day	24.390	56.150	44.798	33.330	27.553	42.071	39.391	35.894	33.333	39.391
7th day	24.390	55.178	34.179	32.486	27.553	42.071	31.649	35.033	33.333	35.894
IInd week	24.390	51.336	33.330	32.486	27.553	31.649	24.390	35.033	32.486	35.033
IIIrd week	19.849	44.798	29.173	27.553	28.360	31.649	24.390	34.179	29.992	35.033
IVth week	17.676	36.760	25.170	25.958	30.818	29.992	23.616	30.818	29.992	35.033
Vth week	22.088	31.649	25.170	19.117	31.649	26.752	23.616	29.992	29.992	33.330
VIth week	26.752	28.360	24.390	23.616	31.649	20.583	14.213	29.992	22.088	31.649
VIIth week	26.752	22.088	24.390	25.171	31.649	22.848	18.393	29.173	17.676	35.033
VIIIth week	27.553	32.486	25.170	31.649	32.486	22.848	19.117	34.179	22.088	38.509

Appendix d. Weekly body weights (in kg) of kids.

Age of kids	Kid No. 3210	Kid No. 6783	Kid No. 6784	Kid No. 908	Kid No. 3221	Kid No. 3224	Kid No. 910	Kid No. 3233	Kid No. 3234	Kid No. 3237
At birth	1.3	2.5	2.5	1.5	1.8	2.0	2.5	2.0	2.0	1.7
Ist week	1.9	3.4	2.9	1.8	2.1	2.3	2.5	2.6	2.4	2.4
IInd week	2.0	3.7	3.3	1.8	2.1	2.3	2.1	2.3	2.2	2.8
IIIrd week	2.1	3.6	3.6	2.4	2.3	2.3	2.5	2.4	2.3	3.0
IVth week	1.9	3.7	3.6	2.6	2.4	2.6	2.8	2.5	2.4	3.5
Vth week	2.3	3.8	3.7	3.8	2.8	3.0	3.4	2.5	2.5	3.2
VIth week	2.7	4.1	4.1	3.0	3.0	3.3	3.9	2.9	2.8	3.5
VIIth week	2.3	4.6	4.7	3.1	3.0	3.3	3.4	3.0	2.8	4.0
VIIIth week	2.6	5.1	5.3	3.6	3.6	3.6	4.2	3.3	3.1	4.6

SERUM IMMUNOGLOBULIN LEVEL IN KIDS AND ITS ASSOCIATION WITH GROWTH AND MORTALITY

BY

NANDAKUMAR P.

ABSTRACT OF A THESIS

Submitted in partial fulfilment of the
requirement for the degree

Master of Veterinary Science

Faculty of Veterinary and Animal Sciences
Kerala Agricultural University

Department of Animal Breeding and Genetics
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
Mannuthy - Trichur

1981

ABSTRACT

Various aspects of transfer of passive immunity from the dam to the kid and its probable associations with various parameters as genetic group type of birth, birth weight, survivability and growth were studied.

The sera of neonatal male kids were subjected to Zinc Sulphate turbidity test and the optical density values were converted into Ig concentration (mg/ml) using the prediction equation prepared from known strengths of commercial bovine gammaglobulins.

Pre-colostral Ig levels were estimated in five kids. They were then bled at bihourly intervals to locate the post colostral peak. The trend in post colostral serum Ig level and the effect of periods and individuals on it were analysed. Magnitude of peak Ig level was estimated in 51 kids. The trend in serum Ig levels was estimated in ten kids on alternate days during the first week and weekly once thereafter upto eight weeks. The variation due to individuals and periods were analysed.

The effect of genetic group on the post colostral peak of serum Ig level were analysed in 20 Saanen x Malabari (SM) 13 Saanen x Saanen-Malabari (SSM) and 12 Saanen x Alpine-Malabari (SAM) kids. The effect of type of birth on post

colostral peak level of serum Ig in 12 single kids, 31 twins and 9 triplets were studied. The correlation between birth weight and post colostral peak of serum Ig in 51 kids was estimated.

The mean post colostral peak level of serum Ig in kids died within two months was compared to that of population. The percentages of mortality in kids with above and below 70 mg/ml of serum Ig were calculated separately. The correlation between post colostral peak level of serum Ig and weight gain at 56 days was also calculated. The correlation between weekly trend in serum Ig level and the corresponding body weights was calculated.

The pre-colostral Ig level ranged between zero and 0.94 mg/ml with a mean of 0.4156 mg/ml. The Ig level rose rapidly in sera and reached a peak level in a mean duration of 17.36 hours, where after that began to decline gradually. The variation between individuals and periods was found significant. The Ig level at the peak ranged between 42.975 and 107.64 mg/ml with a mean of 73.580 mg/ml. The mean Ig level was the highest on the third day. The Ig level declined gradually by 6-7 weeks of age reaching a mean level of 25.3279 mg/ml whereafter it began to rise again. There were significant variations in the above trend between individuals and periods.

The genetic group had significant effect on the post colostral peak level of serum Ig. The means of Ig level in GM, SAM and SSM kids were, 76.9399 mg/ml, 69.7028 mg/ml and 60.0569 mg/ml respectively. The means of Ig level at the peak was 73.014 mg/ml in single kids, 75.0091 mg/ml in twins and 61.4406 mg/ml in triplets, though the differences were statistically not significant. The positive correlation of 0.2620 noticed between birth weight and post colostral peak level of serum Ig was also not significant.

Kids died within two months had significantly lower mean Ig level at the post colostral peak (56.771 mg/ml) than the population mean (73.5851 mg/ml). The mortality rate was 44 per cent in kids with below 70 mg/ml serum Ig and the same was only 3.84 per cent in kids with and above 70 mg/ml of serum Ig. The negative correlation of (-0.1554) between post colostral peak level of serum Ig and weight gain at 56 days was not significant. The positive correlation of 0.6932 between weekly trend in serum Ig level and body weight during corresponding periods was significant.