LIPID AND MINERAL PROFILE OF BLACK BENGAL BREED AND ITS CROSSES

SUBMITTED TO THE
BIRSA AGRICULTURAL UNIVERSITY
RANCHI, JHARKHAND

By

Sunil Toppo


IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF VETERINARY SCIENCE IN

VETERINARY BIOCHEMISTRY

2007
ABSTRACT OF THESIS
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ABSTRACT

The experimental animals of 10 to 12 months of age, having about 10-12 kg body weights were selected. Blood sample was collected aseptically from the jugular vein of the experimental animals. To collect the serum, blood was collected without anticoagulant and allow to clot at room temperature by placing the tube in slanting position. The clear supernatant serum was poured off into vial along the side of the tube, serum was refrigerated until analysed.

The genetic make up and environmental effect differentiate the different breeds of goat. It is expressed by the synthesis and degradation through metabolism of different substrate and exchange of metabolites. The study on these metabolites and as well as minerals were under taken to compare variation as well as breeds characteristics of Black Bengal (BB) and its crosses, Black Bengal X Beetal (BTB), Black Bengal X Sirohi (BS).

Blood samples were collected from experimental animals from three groups i.e. Gr. I (BB), Gr. II (BTB) and Gr. III (BS) from jugular vein. Serum was obtained and stored till analysis was overed. Among the biochemical constituents total serum lipid was appeared to be higher \((2.974 \pm 1.1448) \text{ gL}^{-1}\) in BTB followed by BB and BS. Such variation might be due to less water retention in muscle as the amount of water in lean meat is greater than fat meat. Total fatty acids content in serum were found to be more in BB \((0.1358 \pm 0.0129) \text{ mML}^{-1}\) with respect to BTB and BS. It might be due to variation in lipid metabolism in which these molecules are utilized for energy purpose in ruminants.

Total serum cholesterol reveal no significant difference among three genetic group.
Glycerides appears to be significantly low (p < 0.01) in BB (0.123 ± 0.006) mML\(^{-1}\) as compared to BTB and BS such finding affects the fat deposition in the body tissues as confirmed by indicating estirification with free fatty acids.

Like cholesterol, total serum phospholipid did not showed variation, which are mainly associated as a structural lipid. Sodium and potassium level in serum of BB and its crosses (BTB and BS) were not found significant different. However, potassium level were found to be low as compared to sodium among all crosses (BTB, BS and BB).

Based on the present findings, Black Bengal and its crosses can be characterized biochemically as per neutral lipids specially fatty acids and glycerides.

Serum mineral specially sodium and potassium level can not be used for characterization biochemically.

The detail biochemical characterization of fatty acids and glycerides specially from muscles are suggested for future studies in these species, which may be useful for meat quality.
INTRODUCTION

Goat provides a dependable source of income to 40% of the rural population below the poverty line in India who do not possess any land. Yet the vast majority of the poorer section of the rural population depends on the goat rearing for subsistence and to meet the household occasion of need for meat and milk.

Goats are one of the earliest discovery of mankind in prehistoric times as ready and easy source of meat. The human race, however, took little time to understand the value of its milk, hair and skin. Presently world-wide distribution of goat shows that the number of milch type goat are more in the temperate zone and dual type or meat type goats are primarily located in the subtropical and tropical Asian and African countries (Bhattacharya; 2002) In Asia, the major contribution of goat is towards meat, milk and wool (Mohair, Pashmina etc.)

As we know that the geographical location and agro climatic condition of Jharkhand is fully favourable for goat farming. Jharkhand is plateau and rich in plants. 29% of Jharkhand is covered with dense and rare Jungle(forest) which can provide feed to goat easily. Goat farming can also solves the malnutrition problem, which occurs generally due to protein deficiency. Protein requirement of poor people of Jharkhand can be easily met through milk and meat of goat. We the research scholar or scientist can raise economic and social status of poor by facilitating honestly, Self lessly through research on goat.
Sufficient research had been reported in the area of genetics, breeding and nutrition in goat, but this species was neglected with regards to exploitation in biochemical characterization with reference to metabolic lipid profiles of different breeds of goat. It differ from species to species and breed to breed. In this regard some work has been done in cattle, sheep, yak, horse, Pig but goat was remain neglected specially in Jharkhand. In this respect, some work had been exploited with regard to enzyme and metabolic profile of different breeds of goat and its crosses.

But lipid serve as one of the most important reserved fuel besides, its role in structural lipid. Due to paucity of information in these area.

The present investigation were taken with the following objectives:

1. To study the variation in neutral lipid profile.
2. To find out the phosholipid contents of serum.
3. To evaluate the pattern of change due to different breeds of goat in certain marker mineral associated with metabolism.
LIPID:

Biological lipids are a chemically diverse group of compound. The fats and oils used almost universally as stored forms of energy in living organism. These lipids play an important role in cell structure and function. Lipid forms important constituents of tissue in body specially phospholipids in brain besides it provide fuel. Lipids also act as heat insulators and as reserve supply of energy. It gives up building block for different high molecular weight substances. It serves as important constituent and hormone, sphingolipid, cerebrosides etc. They produce metabolites through oxidation in the tissues which are used in inter – conversion of substances. The phosphatides of blood platelets are involved in the production of thromboplastin activity in the early stages of blood clotting. It also acts as a padding material for cell membranes for protecting internal organs. They are constituent of cell membrane and are thus concerned with the phenomena of cell permeability and cell organization (Dev 1997 & Oser 1979).

Total Lipid:

Call and Call (1974) studied the different level of dieldrin on diet to the serum lipid profile. He observed that serum total lipids were increased by 5, 15 and 75 ppm of dieldrin treatment but not by 10ppm. Female had higher value of total lipid than that of male but cholesterol level did not show any significant changes.
Varshneya et al. (1988 a) studied the toxic effect of endosulfan in cockerals. They fed endosulfan through ration @ 50 and 100 ppm to 8 weeks old white leg horn cockerals and observed a significant increase (p<0.05) in serum total lipid and cholesterol concentration.

Rahim et al. (1991) reported that after administration of sun dried cassava root meal to the rabbit/Goat, there were no change in serum total lipid was observed.

Chaudhary et al. (1993) found significantly reducing level of total lipids with the effect of C. luteum and colchicines in rabbit/goat serum.

Altunok et al. (2001) studied the effect of dietary sunflower oil refinery by products on blood triglycerides, total lipid and cholesterol. Quails were grouped in four groups in equal ratio of male and female. They were fed different dietary fats on all the four groups. They observed that all the parameters were not affected by the different dietary fats.

Mausa et al. (2002) replaced after 10 and 20% olive pulp in basal diet. There was no significant difference in serum total lipid in experimental group with control group.

Macojora et al. (2003) observed that after i/m injection of triamcinolone there were considerable changes in the lipid metabolism.

Arslan et al. (2004) studied the effect of 100mg carnitine chlohydrate/litre of drinking water on blood serum components. L- carnitine significantly (p>0.05) affect the serum cholesterol, total lipid and triglycerides.
**NEUTRAL LIPID:**

Some specialized lipid plays important role in the transport of fatty acid. Lipid like cholesterol is excreted in bile and as such reabsorbed from the intestine and rest comes out through faeces.

Neutral fats are simplest lipid constructed from fatty acids viz. triglycerols, triacyl glycerol provide stored energy and insulation. The specialized cell of animals store large amounts of triacylglycerols as fat droplet and some amount remain in dynamic stage in blood.

**FATTY ACIDS:**

Fatty acids are obtained by the hydrolysis of fats. They occurring in natural fats usually contain an even number of carbon atoms because they are synthesized from 2 carbon units and straight chain derivatives. The straight chain may be saturated containing no double bonds or unsaturated (containing one or more double bonds).

The lipids of gonads contain a high concentration of polyunsaturated fatty acids which suggest the importance of reproductive function. They effect on the prolongation of clotting time and increase the fibrinolytic activity. They retard atherosclerosis being esterified and emulsified with cholesterol and are incorporated into lipoproteins for transport to the liver for further oxidation. They cure skin lesion. The deficiency of these fatty acids in the diet of babies causes eczema.

Hood, (1991) studied the effect of diets containing fat with different fatty acid on serum lipid profile. Quail fed on a diet containing tuna oil had the lowest blood cholesterol followed by sunflower or linseed oil and then beef
dripping which has the highest cholesterol in all these diet. The linseed and tuna oil treated group showed higher level of n-3 fatty acid in comparison with beef and sunflower treatment groups.

Bas et al. (1992) reported that water and lipid contents fatty acid distribution. They determined in 11 samples taken from the Omentum majus of 5 dry alpine goats sample location was explained between 20 & 30% of the total variance in water and lipid contents and from 5.5 to 45.4% of the total variance in fatty acid distribution. They observed increased samples thickness which was associated with an increase in lipid content and in saturated fatty acid percentage sample taken in proximity of the omentum tissue attached to the rumen and abomasums had the highest content.

Rossi and Scharrer (1992) studied the effect of endothelin 1, a recently discovered vasoconstrictor hormone, on levels of plasma lipids in pygmy goats. Endothelin samples were taken by puncturing the jugular vein immediately before and 60, 150 and 240 minutes after injection. They observed that endothelin 1 in comparison to vehicle significantly increased plasma free fatty acid levels. It was concluded that in addition to its vasoconstrictive action, endothelin 1 also had metabolic effects.

Weber et al. (1993) reported that the glycerol kinetics and total fatty acid (F) oxidation of trained African pygmy goats were measured by continuous infusion of (2-3H) glycerol and indirect calorimetry during trademill exercise at 40, 60 and 85% maximal O₂ consumption (VO₂Max). Weather rates of F mobilization and utilization were eventually matched as exercise intensity increased in goat? They observed that the mean rate of glycerol released in the circulation (Raglycerol) was 3.83 ± 0.11 at rest, 7.69 ± 0.88 at 40% VO₂
reached a maximum of 15.32 ± 0.95 at 60% VO\textsubscript{2} max and return to 10.53 ± 0.76 µmol/kg min\textsuperscript{-1} at 85% VO\textsubscript{2,max}.

Hill brick \textit{et al.} (1995) experimented in the chemical composition of lipid extracted from the fleece of intact and gonadectomized Australian Kashmiri goats (\textit{Caprahircus laniger}). Lipid was extracted with petroleum ether or choloform /methanol and analysed by gas chromatography and gas chromatography/mass spectrometery. They reported the fatty acid composition of buck fleece lipid is more complex than respectively.

Hill brick \textit{et al.} (1996) reported Fleece samples were collected from male kashmiri goats (\textit{Capra hircus laniger}) at various times throughout the year. They observed that lipid was extracted with chloroform/methanol azeotrope, saponified and analysed for short chain fatty acids (c\textsubscript{2}-c\textsubscript{10}) by gas chromatography and a combination of gas chromatography and mass spectrometery. In males, there were increased amounts of lipid and ethyl-branched fatty acid in fleece samples shown between March and September compared with samples shown in November and January. They also showed that the increases in the amounts of lipid and ethyl-branched fatty acids corresponded with the breeding season and the period when the male odour was increased. This supports the assumption that ethyl-branched fatty acids may act as a pheromone.

Berra \textit{et al.} (1997) studied 22 men and 13 women aged 50-80 yrs, all suffering from dismetabolism related to atherosclerosis. They were chosen to take part in an experiment to compare the “prudent” diet prescribed for such dismetabolism with one which included goat milk products. Red blood cell membrane were analysed for lipid composition before the treatment and at 1,
3 and 6 months during the treatment. The result showed an increase in protein content, lactosylceramide (the main neutral glycolipid of red blood cells) and short chain fatty acids in the subjects who consumed goat milk products.

Uysal et al. (1999) observed that supplementation of ration with L-carnitine and vitamin-C showed the certain lipid – lowering effects in male quails which may be the result of increased beta – oxidation of fatty acid.

Rao et al. (2003) studied threee groups of five indigenous male goats 5-6 months of age and offered control concentrate mixture (Group-I) and those of Group-II and III were fed experimental concentrates containing 15 and 25% of water washed neem (Azadirachta indica) seed kernel cake (NKC). After 180 days of feeding the goats were slaughtered. They studied detailed lipid profile and fatty acid composition for certain physico-chemical characteristics fatty acids and identified capric, lauric, myristic, myristoleic, palmitic, palmitoleic, hepta-decanoic, stearic, oleic, linoleic acid. They also studied a significant increase was noticed in unsaturated fatty acid content and decrease in total saturates. It is also included that NKC feeding has the ability of reducing lipid content and increasing the unsaturated fatty acid.

**GLYCERIDES:**

Glycerides (neutral fat) are neutral esters of glycerol and fatty acids. An example is tristearin, synthesized in living tissues from one molecule of glycerol and three molecules of stearic acid, three molecules of fatty acid entering into the composition of a neutral fat. All may be the same, as in
tristearin. However, more commonly two or three different fatty acids are involved; Such a fat is called a mixed glyceride, the composition being indicated by the name oleodipalmitin, stearodiolein, oleopalmito stearin etc. Mixed glycerides occur much more commonly than do simple glycerides such as tristearin, tripalmitin, and triolein. Naturally occurring animal fats consist largely of mixed glycerides of oleic, palmitic and stearic acid. Mutton fat contains more stearic acid and less oleic acid than Pork fat. Human fats contain a high percentage of oleic acid. Butter fat consist largely of glycerides of palmitic and oleic acids.

Hood, (1991) reported the effect of diets containing fat with different fatty acid on serum lipid profile. Quail fed on a diet containing tuna oil had the lowest blood cholesterol followed by sunflower or linseed oil and than beef dripping which has the highest cholesterol among all these diet. He observed that serum triglyceride concentration were lowest in quail fed.

Rossi and Scharrer (1992) studied the effect of endothelin 1, a recently discovered vasoconstrictor hormone on levels of lipids in pygmy goats. Endothelin 1 was injected intraperitoneally (1.72µg/kg BW) and blood samples were taken by puncturing the jugular vein immediately before and 60,150 and 240 minutes after injection. They observed that endothelin 1 in comparison to vehicle significantly increased free fatty acid levels, Where as, plasma triglyceride were significantly reduced.

Hocking et al. (1994) reported plasma triglycerides concentration in fat line fowls which was 30% higher than in lean line fowls fed adlib and restricted fowls of both genotypes.
Hermann et al. (1998) studied the effect of dietary chromium (Cr), Copper (Cu) and Zinc (Zn) on plasma lipid concentration in male Japanese quail. Quails were randomly assigned to 1 of 15 diets containing a definite level of Cr, Cu and Zn. After 6 weeks, blood sample shows plasma triglyceride concentration was significantly affected by the interaction between dietary Cu and Cr and interaction between dietary Cu and Zn.

Yuan et al. (1998) studied the effect of increased intake of saturated fat on plasma triglycerides and lipoprotein composition. In interaction (p=0.05) between dietary cholesterol and fat intake was observed for plasma triglycerides and was specific to change observed in VLDL composition. Diet induced change in lipoprotein, Triglycerides and Phospholipid composition were greatest in portomicron.

Dunshea et al. (2000) experimented in multiparous saanen dairy goats. They used to compare in vivo and in vitro lipid metabolism. The goats were infused simultaneously with a mixture of (2-4H) glycerol and of (1-14c) – palmitic – stearic and oleic acid complex in plasma in early (day 11, π=4) mid (day 37, π+4) and late lactation (day 80, π=3) to determine in vivo lipid kinetics. They observed that there were no significant differences between NEF and glycerol released at any stage of lactation.

Altunok et al. (2001) studied the effect of dietary sunflower oil refinery by products on blood triglycerides. Quails were divided into four groups in ratio of male and female. They were fed different level of dietary fats to all groups. They observed that triglyceride was not affected by the different dietary fats.
Arslan et al. (2004) studied the effect of 100 mg carnitine chlohydrate/litre of drinking water on blood serum components of Japanese quails. They observed that administration of L-carnitine non-significantly affect the serum total lipid and triglycerides (P>0.05).

**Serum cholesterol:**

Cholesterol is vital substance for life. Animals can not live without cholesterol which is stored in nature (Oser 1979). It is essential constituent of cells i.e, brain and nervous tissues, liver, kidney, spleen and skin. It helps in the permeability of the cells. It function as the defensive action in controlling the red cells from being easily hemolysed. It is antagonist of phospholipids. It is excreted from body through faeces after conversion to bile salts (Dev, 1997).

Cholesterol play role as a precursor of steroid hormone and bile salts. Progesterone, Oestrogen and the adrenal corticoids are derived from cholesterol. Cholesterol is also important in the transport of fatty acids. The regulation of serum cholesterol level which depends not only the rate of synthesis but also rate of degradation and excretion of cholesterol in liver (Oser, 1979).

Smith and Hilker (1973) observed that cholesterol concentration of quail on plasma SAFA (40% of energy from saturated fatty beef tallow), HSLF (50% of energy from sucrose and LSHF(53% of energy from beef tallow) diets which showed a sharp increase when cholesterol was added to the diet. The mean cholesterol concentration were significantly higher on the SAFA, USHF
and ATH (53% of energy from beef tallow with 12% of energy from sucrose and 1% added cholesterol) diets than cholesterol.

Call and Call (1974) studied the different level of dieldrin on diet to the serum lipid profile. He observed that serum total lipid were increased by 5, 15 and 75 ppm of deldrin treatment but not by 10 ppm. Female had higher value of total lipid than that of male but cholesterol level didn’t show any significant changes.

Kumar and Rawat (1975) studied serum cholesterol level in white leg horn bird in relation to age, sex and reproduction. They observed increase cholesterol levels with age in general. However, age, sex could not influence the serum cholesterol significantly.

Verma and Pandey (1975) estimated total cholesterol of adult Murrah buffaloes which was divided into 3 group viz. non-lactating pregnant (over 6 months). Lactating non-pregnant and non-lactating non-pregnant. They reported highly significant differences in cholesterol contents among three physiological groups.

A survey of seasonal and area variations in eight constituents of bovine sera was estimated by Ross and Halliday (1976) over a period of 18 months. They observed higher cholesterol level during the summer months and in the North, North East and North West zone of India.

Kaspar and Norris (1977) studied serum chemistry values of one hundred and sixteen colony control dogs (pure breeds) and beagles in respect to age, sex and family line. They reported increase in cholesterol level with increasing age. Female had higher level cholesterol than males (ox), the rate
of increase in serum cholesterol with age was greater in males than in females.

Kadiokla et al. (1977) recorded rise in total cholesterol (36.56%) in broilers after triometon poisoning although the result was not significant.

Erdos and Fontaine (1978) evaluated normal blood values of three breeds of pigeon (Carrier pigeons, Cologne porpoise and Madena gazzi) in two age group of 10 and 46 month. They concluded that serum lipids varied significantly among birds of different breeds, age and sex. The highest lipid values were found in Madena Gazzi breed.

Pavlovic and Vitic (1979) observed no sex difference in the concentration of total lipoprotein and cholesterol or in the amount of cholesterol isolated from β-lipoprotein in the blood serum, obtained from sheep of both sexes aged one and half year to six years.

Devraj et al. (1985) estimated total serum cholesterol in surti buffalo calves from birth to sexual maturity. The total cholesterol level was found to increase after feeding cholostrum. These increase was enormously towards puberty and sexual maturity. The level of total cholesterol was found to be high in female calves.

Singh and Prasad (1985) estimated total serum cholesterol in sheep and goats of four different physiological status. The values of total cholesterol in four groups was found to differ significantly (P<0.01).

Chiericato et al. (1986) reported no sex related difference in cholesterol in camelus dromedarius.
Joshi and Kumar (1987) reported that there was a significant decrease in blood cholesterol level when two week old Japanese quail chick were given Liv-52, a proprietary preparation by Himalaya Drug Company @0.5 gm and 1 gm/kg of food for a total period of five weeks.

Mohar et al. (1987) studied that sex and the interaction between sex and age had no significant effect on carcass fat when they had taken 8th and 8th week of age of Japanese quail for study.

Panda et al. (1987) studied the Quail’s blood cholesterol level when they were fed graded level of dietary aflatoxin from 6th to 35th day of age. There were marked decrease in serum cholesterol level with increase in level of aflatoxin in feed. The decrease in cholesterol level may be due to liver damage by aflatoxin.

Varshneya et al. (1988) studied the toxic effect of endosulfan in cockerels. The fed endosulfan through ration @ 50 and 100 ppm to 8 weeks old white leg horn cockerels and observed a significant increase (P<0.05) in serum cholesterol concentration.

Radcliffe and Tramposeh (1988) studied the change in serum cholesterol level when atherogenic diet given to quail replacing glucose by 0.25, 0.5 and 1% cholesterol. After 4 weeks, serum cholesterol level increased by 15, 127 and 229% respectively on different diets. The increase were result of rise in cholesterol in the very low density lipoprotein (VLDL) and low density lipoprotein (LDL) fraction.

Bhattacharya (1989) studied factors regulating plasma cholesterol concentration. The cholesterol absorption and faecal excretion rather than cholesterol synthesis, play major role in regulating plasma cholesterol
concentration in high and low responding rhesus monkey. The high responding monkey were those who respond with great increase in plasma cholesterol when fed high cholesterol diet but low responding monkeys were those who respond with mild increase in plasma cholesterol when fed on identical high cholesterol diet.

Sharma et al. (1990) reported increase serum cholesterol concentration with age in both the sexes of chegu goat. Females showed significantly higher cholesterol concentration than males in higher age groups. Although there was no significant sex difference in lower age group.

Singh and Bhattacharya (1990) studied fractions of serum cholesterol in Hariana (H) and their F₁ crosses with jersey (JH) brown swiss (BH) and Holstein Friesian (FH). They measured on days 9 and 19 of exposure at different ambient temperature in Psychrometric chamber. They found significantly higher level among crosses where highest in FH and lowest in JH animals was observed.

Vecchiotti et al. (1990) studied blood parameters monthly throughout lactation in a form with 400 loose housed saanen goats. They found significant variations in blood cholesterol.

Hood, (1991) studied the effect of diets containing fat with different fatty acid on serum lipid profile. Quail fed on a diet containing tuna oil had the lowest blood cholesterol followed by sunflower linseed oil and then beef dripping which has the highest cholesterol in all these diet.

Inoue et al. (1995) studied the response of serum lipid to dietary cholesterol feeding and was compared in commercially available (CA) and hyperlepaemia and atherosclerosis Prone (LAP) Japanese quail in (CA). The
cholesterol feeding alone failed to induce significant hypercholesterolaemia but cholesterol in combination to maize oil at a level of 2% is able to do the same. Ad libitum feeding of 0.5% cholesterol without maize oil induced significantly hypercholesterolaemia in LAP quail.

Siegel et al. (1995) selected 3 lines i.e, control (cl) high response (44) and studied the effect of dietary cholesterol on lipid profile. They observed that plasma cholesterol increase when cholesterol was given and response was in order of HL, CL, than LL. Dietary cholesterol significantly increased esterified cholesterol (EC) to non-esterified cholesterol (NEC).

Chaudhary et al. (1993) studied on effect of C, luteum and colchicine in a rabbit serum. They observed a significant reduced the levels of serum cholesterol.

Bugalia and Kumar (1996), showed significant increase in plasma cholesterol at 8 and 12 weeks of age in male foals (Equus Caballus).

Delloma and Cavallina (1996) analysed blood plasma from captive healthy Egyptian vulture. They reported decreased in cholesterol value with age.

Gorezalez et al. (1996) studied influence of season on metabolic profile of dairy cattle in Southern Brazil. They observed that concentration of cholesterol were relatively high in winter.

Sudan et al. (1996) estimated some of the blood profile of exotic sheep maintained under the temperature condition of Kashmir. The effect of breed of serum cholesterol level was not significant.
Velasquez et al. (1996) studied early pregnancy, 32 crossbred goats aged around 5 months were fed (1) a restricted diet (2) a standard diet of hay, maize, soyabean meal, wheat and minerals (controls), or (3) and (4) high lipid diets with 2.5 and 5% tallow respectively. They found that serum cholesterol concentration was significantly higher in groups 3 and 4 than in groups 1 and 2 on days 9, 12, 15, 18 and 21 of pregnancy.

Prabhakaran et al. (1997) analyzed blood samples of adult albino mice, adult guineapigs and adult NZW rabbits. The cholesterol values were higher in females in all three species.

Berra et al. (1997) studied 22 men and 13 women aged 50-80 years, all suffering from dismetabolism related to atherosclerosis. They were chosen to take part in an experiment to compare the “prudent” diet prescribed for such dismetabolism with one which included goat milk products. They observed that the cholesterol content was below the original by the end of the experimental study & also found that Red blood cell membranes were analyzed for lipid composition before the treatment and at 1,3, and 6 months during the treatment.

Yuan et al. (1998) studied the effect of increased intake of saturated fat and cholesterol on plasma triglycerides and lipoprotein composition. In interaction (P=0.05) between dietary cholesterol and fat intake was observed for plasma cholesterol. Diet induced change in lipoprotein total cholesterol are greatest in Portomicron.

Hermann et al. (1998) studied the effect of dietary chromium(Cr), copper (cu) and zinc (zn) on plasma lipid concentration in male Japanese quail. Quails were randomly assigned to 1 of 15 diets containing a definite
level of cr, cu and zn. After 6 weeks blood sample shows no significant effect on plasma total cholesterol but plasma HOL- cholesterol was significantly affected by interaction between dietary Cu and Cr.

Naqvi et al. (1998) investigated the plasma cholesterol concentration. It was found to be decreased at 8 hours and remain low until 40 hours, followed by increased to prefasting concentration at 48 hours. Total solid variation did not show variation during 48 hours of fasting.

Iwasaki et al. (2000) studied the effect of cholesterol feeding on hyperlipidaemia atherosclerosis prone (LAP) Japanese quail. The apparent cholesterol absorption rate of LAP was compared with that of commercially available [CA]. Japanese quail after 14 days of cholesterol feeding showed cholesterol excretion of LAP was significantly lower than that of CA quail.

Goswami et al. (2000) estimated plasma cholesterol from cross bred bulls (Jersey x Hariana and Holstein friesian x Hariana) in 4 season viz; hot-dry May-June, hot humid-July-August, Autumn Oct - Nov; Winter; December-January. They reported the correction co-efficient of various climate elements with cholesterol which was non-significant.

Ramprabhu and Dhanapalan (1999) studied blood profile of sheep belonging to two breeds synthetic and Nilgiri sheep during three season of the year. The highest cholesterol content was observed with a significant difference in cholesterol level between breeds during rainy season. These investigation confirmed the necessity to consider the influence of breed and season upon serum cholesterol level.
Onifade et al. (1999) reported that yeast addition in diet significantly reduced serum cholesterol level and maintained serum enzymes at normal ranges.

Altunok et al. (2001) studied the effect of dietary sunflower oil refinery by products on blood cholesterol. Quails were grouped in four (4) in ratio of male and female. They were fed different dietary fats on all the four groups. They observed that the blood cholesterol was not affected by the different dietary fats.

Mousa et al. (2002) reported that cholesterol concentration increased (p<0.05) in blood serum of groups of rabbit fed diets containing 10 or 20% olive pulp compared with the control group.

Arslan et al. (2004) studied the effect of 100mg carnitine chlohydrate/litre of drinking water on blood serum components of Japanese quails. They observed that administration of L-carnitine insignificantly affect the serum cholesterol (P>0.05).

Herichova et al. (2004) measured the cholesterol profile in Japanese quail kept in eight: dark cycle (16:8hr). They observed that no significant daily pattern in concentration of plasma cholesterol.

TOTAL SERUM PHOSPHOLIPID:

Lipids are constituent of cell membranes and are thus concerned with the phenomena of cell permeability and cell organization. They are the best reserve of food material in the body. They act as insulator for the loss of body heat. It also acts as a padding material for protecting internal organs. (Dev 1997 and over 1979).
Phospholipids are esters of fatty acids with glycerol containing on esterified phosphoric acid and a nitrogen base. They help in blood clotting. It acts as carrier of inorganic ions across the membranes. It is found in blood cell, plasma and all tissue cells in combination with proteins and other lipids. They form the structure of membranes. They increase the rate of fatty acid oxidation. Matrix of cell wall, myelin sheath, microsomes and mitochondria. (Oser 1979).

Shukla et al. (1992) experimented in male Barbari and Black Bengal goats aged 4 month old. They were fed on a mixture containing crushed maize, groundnut cake, wheat bran, mineral mixture and salt plus oat hay. The goats were given diets at the standard rate 100 L or at 75% of standard rate 75 H without or with a biostimulater (dried preparation of buffalo spleen and liver). 5 mg / head (O & B, respectively) every 2 weeks. After slaughter the liver were taken for estimation of lipid. They found that the concentration of total phospholipid as lecithin was 41.89, 44.09, 37.19 and 41.27 mg/g for groups 100 L-O, 75 L-B and 100 L-B respectively.

Yuan et al. (1998) studied the effect of increased intake of saturated fat on plasma triglycerides and lipoprotein composition. In interaction (P=0.05) between dietary fat and cholesterol intake was observed for plasma triglycerides and was specific to change observed in VLDL composition. Diet induced change in lipoprotein and phospholipid composition were greatest in poromicron.
MINERALS

Goats have a dietary requirement for the macro and micro minerals viz, calcium, chlorine, copper, cobalt, iodine, iron, magnesium, manganese, phosphorus, potassium, selenium, sodium, sulphur, zinc, chromium, etc. Goats may also require other trace elements i.e, arsenic, boron, bromide, fluorine, molybdenum, nickel, silicon, tin and vanadium which have been shown to have a physiological role in one or more species.

MACRO-MINERALS:

1. Sodium and Potassium:

   Among the macro minerals, sodium is the principal extracellular cation and anion in the body. The dietary sodium requirement of growing goat is 0.08 to 0.10 percent of the diet.

   Sodium is present in the body fluid as the sodium ion. The major functions of the sodium ion concern with regulation of crystalloid osmotic pressure. It is the major components of the cations of the extracellular fluid and exists in the body in association with the anions; chloride, bicarbonate, phosphate and lactate.

   It is largely associated with chloride and bicarbonate in regulation of acid-base equilibrium. It maintains the osmotic pressure of the body fluid and thus protects the body against excessive fluid loss. Sodium ion plays an important role in the absorption of glucose and galactose as well as amino acids from the small intestine. It maintains the normal water balance and distribution. Sodium ion is involved in initiating and maintaining the heartbeat.
It maintains the normal neuromuscular function. It functions in the permeability of the cell.

Potassium is the third most abundant mineral in the body of the goat and is the most abundant mineral in the muscle tissue. Potassium is involved in electrolyte balance and neuro-muscular function. It also serves as the monovalent cation to balance anions intra-cellularly, as part of the sodium potassium pump physiological mechanism. Signs of potassium deficiency include anorexia, rough hair coat, emaciation, inactivity and ataxia.

Potassium is largely present in the intra-cellular fluid and it is also present in small amounts in the extracellular fluid because it influences cardiac muscle activity. It plays an important role in the regulation of acid-base balance in the cell. It maintains osmotic pressure. It functions in water retention. It is essential for protein biosynthesis by ribosomes. The glycolytic enzyme pyruvate kinase requires K\(^+\) for maximal activity.

Electrocardiograms of potassium deficient goats showed reduced heart rate and increased electrocardial intervals.

Khan and Taneja (1983) collected blood samples from 322 adult Marwari males were analysed. 58% of goats were of the high potassium (HK) and 47% of the low potassium (LK) type. Whole blood potassium concentration was 21-34 and 9-19 meq / litre in HK and LK goats respectively.

Bhat (1987) described no significant difference between the breed in blood potassium or sodium concentration and neither of these were significantly affected by sex.
Mangal Raj et al. (1988) reported in 58 goats, the proportions of animals with high and low potassium type was 43.1 and 56.9% respectively. Animals of low potassium type had significantly higher concentration of sodium in blood than those of high potassium type did not significantly affect reproductive traits.

Schreiber et al. (1988) seen the concentration of potassium ion in Barbary sheep blood from 200 tabulated. The results suggested that only the low potassium allele (KC1) was present. The monomorphism was distributed to the high degree of inbreeding in the population.

Mariana et al. (1989) described the frequencies of all alleles for high and low Erythrocyte potassium concentration which were 0.49 and 0.51 respectively in ram and in ewes. The values of reproductive traits were tabulated for sheep with the 6 combinations of Hb and potassium types.

Cappa et al. (1990) reported blood parameter monthly throughout. Lactatoin on a farm with 400 loose-housed saanen goats. They found significant variation on blood Na$^+$ and K$^+$.

Lipecka et al. (1997) reported biochemical polymorphism of erythrocyte potassium level. They studied in 148 Merino 95 Berrichon ducher, 90 Suffolk, 237 Wrzoswka, 31 Karakul and 3697 polish lowland sheep (4 strains). The frequency of H allele was highest in the wrzosowka (0.861) and lowest in the Suffolk (0.0). Gene frequencies differed significantly among the polish lowland sheep strains.

Mert et al. (1998) reported plasma erythrocyte Na and K concentration. They recorded for 112 laying hens, 16 bears 100 sheep and 16 cows. They found erythrocyte K level in hens, bears, Dorset, Hampshire, Lincoln and
German Blackheaded multon sheep and Hotstclh cow. These were 23.05, 46.98, 4.93, 16.68, 16.00, 14.34, 13.95 and 21.00 mEq/L. Erythrocyte Na levels whereas 66.02, 63.80, 131.13, 104.54, 98.91, 107.20, 101.05, and 94.07 mEq/L respectively.

Toharmat et al. (1996) estimated minerals in 10 castrated Japanese goats which were fed on diets differing in mineral content (Sodium and Potassium) consisting of 50% Italian ryegrass hay and 50% concentrate on a DM basis for 21 days. They found that there was no relationship between intake and absorption of sodium and potassium, although retention of both minerals was positive. They also observed that there was no relationship between apparent potassium absorption and plasma sodium.

Mpofu et al. (1998) studied blood samples collected from 40 goats and kept under small holder grazing condition held at sanyati to ascertain their calcium, magnesium, phosphorus, iron, selenium, copper and cobalt status. They observed that the goats were deficient in phosphorus throughout the year marginally deficient in magnesium and copper in the dry season while sodium concentration was at critical level.

Eryavuz et al. (2001) studied the effects of defaunation and zinc supplements on some plasma mineral levels in Angora goats concerting of 24 male Angora goats 10-12 months of age and weighing approximately 18-20 kg. The animals were equally divided into four groupes as faunted (F), defaunted (D), faunted+Zn (F+Zn) and defaunted + Zn (D+Zn). The groups F and D were fed with a control ration containing 35 ppm Zn while the groups F+Zn and D+Zn with the same ration supplemented with 250 ppm Zn and
offered ad libitum for 75 days. They observed that there were no significant differences in the plasma potassium level.

Erdogan et al. (2002) found normal level of Na and slightly lower K level in clinically healthy goats raised in pasture condition of Hayat region; the values were (149.37 ± 2.65) and (149.37 ± 2.65) m mol / litre respectively.
MATERIAL AND METHOD

3.1.1 ANIMALS:

The experimental animals, about 10 to 12 months of age having about 10-12 kg weight was taken from Instructional small Ruminant farm Unit, Ranchi Veterinary College, Ranchi-6. The animals were maintained with feeding schedule as per NRC (National Research Council, 1988). The experimental animals were divided into three genetic group containing Black Bengal (BB); Black Bengal x Beetal (BTB) and Black Bengal x Sirohi (BS), named as group –I, group-II and group- III respectively. Each group consists of six / eight animals of either, sex selected randomly.

3.1.2 COLLECTION OF BLOOD SAMPLES:

Blood samples were collected aseptically from the jugular vein of the experimental animals into one set of sterile glass tubes without anticoagulant.

3.1.3 SERUM COLLECTION:

The blood sample, without anticoagulant were allowed to clot at room temperature by placing the tubes in slanting position. The clear supernatant serum was poured off into vial, along the side of the tube serum was kept in refrigerator until analyzed.
3.2 LIPID ANALYSIS:

3.2.1 Lipid Extraction:

The total serum lipid extraction was done by using the method of Folch et al. (1957).

1 ml of serum sample was taken with 19 ml of Chloroform : Methanol (2:1 v/v). It was mixed well and allowed to stand overnight. The extract was filtered off using What’s Mann No.1 filter paper into 50 ml Erhrmoyer flask. The filter paper with the residue was cut into pieces and transferred to chloroform: Methanol (2:1 v/v) as above for further extraction and kept over night.

The extract was filtered and combined with the previous extract. The combined extract was evaporated to near dryness at 45°C - 50°C in sand bath. For breaking the proteolipids, the dried lipid residue was dissolved in 1/10th volume of original lipid extract in chloroform : methanol : water (64:32:4 v/v/v) and evaporated to near dryness in sand bath at 45°C - 50°C. This step was repeated thrice and the dried residue was dissolved in chloroform : methanol (2:1 v/v) and transferred to a separating funnel for removing non-lipid impurities.

The lipid extracts were layered with 1/5th volume of normal saline (0.9% NaCl) and mixed several times by gentle inversion. This was allowed to stand for 6-8 hrs. at room temperature. The lower chloroform layer was collected evaporated to near dryness in sand bath at 45°C - 50°C and this step was repeated thrice.

The dried extract was dissolved and made up to known volume with chloroform.
3.2.2 TOTAL SERUM LIPID:

The total lipid of lipid extract was determined gravimetrically. A suitable aliquot (1ml) of lipid extract was pipetted into a pre-weight Aluminium cup or Stainless steel planchets and dried at 60° C in an oven until constant weight were reached. The increase in weight gives total serum lipid.

3.2.3 SEPARATION OF NEUTRAL LIPID:

Preparation of thin layer plates:

According to Abramson and Blachs (1964) clean glass plates (20x20 cms) were coated with silica gel G. 30 Gms. Silica gel G were vigorously shaken for 90 seconds with 63 ml of 0.01M Na₂CO₃ solution (Sodium carbonate) in a stoppered Erhhrmoyer flask. The slurry was poured into the spreader, preset for 250 mμ thickness and the plates were coated. The plates were kept at room temperature for setting and drying.

3.2.4 APPLICATION OF SAMPLE:

The dried plates were activated by heating at 110° C for 90 minutes and was cooled. The Lane in the gel of the chromatoplate of sample and standard has been done with the help of pointed needle. The extracted sample and standards were applied in their respective lane with the help of automatic micropipette.

3.2.5 SEPARATION OF NEUTRAL LIPID:

This was done by the solvent system for thin layer chromatography (TLC). The solvents were; Hexane: Diethyl either: glacial acetic acid (60:40:1), Then (90:10:1) of above solvents were used for separation of neutral lipid.
As per the method of Mishra (1968) the plates were developed first for 7.5 cms from the origin in the solvent (60:40:1). It was then air dried and it was again developed for 15 cms. in solvent system (90:10:1).

3.2.6 DETECTION OF SPOTS:

The developed plates were air dried and then lipid spots were identified by exposing the developed chromatograph plates to iodine vapour in a closed iodine chamber. The neutral lipid spots were identified by comparing the Rf value with authentic standards.

\[
Rf \text{ Value} = \frac{\text{Distance traveled by the substance}}{\text{Distance traveled by the solvent}}
\]

3.2.7 ELUTION OF NEUTRAL LIPID SPOTS:

The plates were taken out from the iodine vapour chamber and the developed individual bands were encircled with needle and then separated the lipid into test tube and added 1ml of chloroform in each test tube. It was mixed well. Then upper position of gel was transferred into another test tube and dried in water bath at 45° - 50° C and estimated quantitatively for different neutral lipids.

1.2.8 ESTIMATION OF NEUTRAL LIPID:

Estimation of total serum cholesterol:

Total cholesterol in blood serum/lipid extract was estimated by the method of Zlatkis et al. (1953). 0.1 ml serum was taken in a test tube. Glacial
acetic acid (6.0ml) and colouring reagent (4.0ml) were added. The contents were mixed well. Simultaneously, 0.1 ml of Chloroform as blank and 0.1 ml of standard cholesterol solution (2 mg ml$^{-1}$) were run and similarly treated then the tubes were allowed to cool at room temperature. The optical density was recorded at 540nm in photo electric colorimeter model AE-II Japan.

### 3.3 ESTIMATION OF TOTAL SERUM FATTY ACID:

It was estimated as per Duncombe (1963), 5 ml of chloroform solution containing free fatty acid (10-100µM), 2.5 ml of copper reagent was added in test tube and shaken well by cyclomixer. After removing the supernatant layer with hypodermal needle to 3 ml of the chloroform layer, 0.5 ml of diethyl dithiocarbamate reagent was added and mix well by using cyclomixer. The O.D was read at 440 nm using systronics spectro calorimeter. Suitable standards and gel blanks were run along with each analysis.

### 3.4 ESTIMATION OF GLYCERIDES:

It was measured as per Van Han del and Zilversmit (1957), a known quantity of eluted lipid extract (T.G) was dried in vacuo and hydrolysed with 0.1 N alcoholic KOH at 70° C for 20 minutes. To this 0.2 ml of 0.4 N H$_2$SO$_4$ and 0.1 ml of 0.05 N sodium metaperiodate and 0.2 ml of 20% sodium bisulphite or 0.5 M sodium aresnite, 8ml of chromotropic acid (prepared freshly by dissolving 0.5 mg of chromotropic acid in 10 ml of distilled water and 250 ml of 66% sulphuric acid) were added and mixed. The tubes were
covered with marbles and kept in a boiling water bath for 30 minutes, cooled and read at 570 nm using systronic spectro coloriometer.

Suitable standards and gel blanks were run along with analysis.

3.5 ESTIMATION OF SODIUM (Na\(^+\)) AND POTASSIUM(K\(^+\)) :-

It was estimated by conventional method using flame photometer.

For stock standard 5.85g of NaCl was dissolved in water and diluted to 1 litre. It contains 100 milli equivalent of sodium per liter. Then working standards 10, 11, 13, 14, 15, 16, 17 and 18 ml stock standard solution were diluted to 1 litre with H\(_2\)O. These working standard were equivalent to 100, 110, 120, 130, 140, 150, 160, 170 mM at 1:100 dilution.

For standard potassium 0.746gm of K was taken and the volume was made to 1 litre. It contains 10 milli equivalent of potassium per litre; working standard was prepared by taking 3, 4, 5, 6 and 7 ml of stock standard per liter. These working standard consist of 3, 4, 5, 6, and 7 milli equivalent per liter at dilution of 1:100. The reading was taken for sodium (Na\(^+\)) and potassium (K\(^+\)).

Simultaneously sample was rum at 1:100 dilution. The volume were calculated using standard curve expressed as milli equivalent per litre.

3.6 PHOSPHOLIPID ESTIMATION:-

The total phospholipid in serum was estimated by method of Post and Sen (1967).

An aliquot (0.1ml) of lipid extract was taken into micro kjeldahl and 0.4 ml of 60% per chloric acid solution was added. It was digested directly on a sand bath for 20 minutes. Glass beads (2-3) were added to each flask to avoid bumping during digestion.
0.1 ml of digested solution was taken in a tube and was added to 8 ml water. It was mixed. Then 2.1 ml colouring reagent (1 part of 10% ascorbic acid and 6 parts of 0.42% ammonium molybdate solution) was added. It was incubated in water bath at 37°C for 1 hour. After mixing O.D. was taken at 660 nm in colorimeter model AE-11, Japan against H₂O. Then the value of Pi was multiplied by the factor (25) to obtain the phospholipid content which was expressed as g/l serum.

**CHEMICALS:**

The chemical used in the present study, were of Excellar R or GR quality and were procured from British drug house (India), Merch (India), Sarabhai Merch (India) Himedia (India), Sigma (USA), E.Merch (Darmstand Germany).

**STATISTICAL ANALYSIS:**

The data obtained during present investigation were subjected to statistical evaluation as per Snedecor and Cochran (1989).
RESULTS

NEUTRAL LIPID:

Total Serum Lipid:

Data obtained on total serum lipid content of different breeds of goats are presented in Table 1. The analysis of variance of this data is presented in Table 2. The Black Bengal and its crosses, BTB and BS contain \((2.55 \pm 1.4548), (2.974 \pm 1.1448)\) and \((2.025 \pm 0.4572)\) gL\(^{-1}\) of total lipid respectively. The result showed no significant difference level in total serum lipid content among Black Bengal goat (BB) and its crosses (BTB, BS) as observed in Fig. 1.

Total Fatty acid:

The total serum fatty acid content of different breeds of goats are presented in Table 3. The analysis of variance of this data is presented in Table 4. The Black Bengal and its crosses, BTB and BS contain \((0.1358 \pm 0.0129), (0.1296 \pm 0.0091)\) and \((0.1266 \pm 0.0064)\) mML\(^{-1}\) of total fatty acids respectively. The result did not show any significant difference between groups i.e. Black Bengal (BB), Black Bengal x Beetal (BTB) and Black Bengal x Sirohi (BS). These activity can be shown in Fig 2.

Glycerides in Serum:

Data obtained on serum glycerides level of different breeds of goats are presented in Table 5. The analysis of variance of this data is presented in Table 6. The Black Bengal and its crosses, BTB and BS contain \((0.123 \pm 0.006), (0.158 \pm 0.043)\) and \((0.161 \pm 0.042)\) mML\(^{-1}\) of glycerides respectively. The result showed significant difference \((P<0.01)\) in total serum glycerides concentration among the different breeds. The significantly higher value in BS (Black Bengal x Sirohi) followed by BTB (Black Bengal x Beetal) and BB (Black Bengal) was observed through CD Test. Such difference in glyceride content in serum is clearly evidenced by Fig 3.
Table: 1. The values* of total serum lipid (g L\(^{-1}\)) of different breeds of goat.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Breeds</th>
<th>Total Serum lipid</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Black Bengal</td>
<td>2.55 ± 1.4548</td>
</tr>
<tr>
<td>II</td>
<td>Black Bengal x Beetal</td>
<td>2.974 ± 1.1448</td>
</tr>
<tr>
<td>III</td>
<td>Black Bengal x Sirohi</td>
<td>2.025 ± 0.4572</td>
</tr>
</tbody>
</table>

* Value (Mean ± SE)

Table: 2. Analysis of variance of the data presented in Table 1 showing the total serum lipid content in serum of different breeds of goat.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>S.S.</th>
<th>M.S.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between genetic group</td>
<td>2</td>
<td>18.1168</td>
<td>9.0584 (^{NS})</td>
</tr>
<tr>
<td>Error</td>
<td>21</td>
<td>1018.25</td>
<td>48.488</td>
</tr>
</tbody>
</table>

NS: Non-significant.
Table 3. The values* of total serum fatty acid (mML⁻¹) of different breeds of goat.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Breeds</th>
<th>Total Serum fatty acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Black Bengal</td>
<td>0.1358 ± 0.0129</td>
</tr>
<tr>
<td>II</td>
<td>Black Bengal x Beetal</td>
<td>0.1296 ± 0.0091</td>
</tr>
<tr>
<td>III</td>
<td>Black Bengal x Sirohi</td>
<td>0.1266 ± 0.0064</td>
</tr>
</tbody>
</table>

* Value (Mean ± SE)

Table 4. Analysis of variance of the data presented in Table 3 showing the total serum fatty acid content in different breeds of goat.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>S.S.</th>
<th>M.S.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between genetic group</td>
<td>2</td>
<td>0.0035</td>
<td>0.00175 NS</td>
</tr>
<tr>
<td>Error</td>
<td>21</td>
<td>0.1653</td>
<td>0.0078</td>
</tr>
</tbody>
</table>

NS: Non-significant.
Table 5. The values* of total serum Glyceride (mM L⁻¹) of different breeds of goat.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Breeds</th>
<th>Total Serum Glyceride</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Black Bengal</td>
<td>0.123 ± 0.006ᵃ</td>
</tr>
<tr>
<td>II</td>
<td>Black Bengal x Beetal</td>
<td>0.158 ± 0.043ᵇ</td>
</tr>
<tr>
<td>III</td>
<td>Black Bengal x Sirohi</td>
<td>0.161 ± 0.042ᵇ</td>
</tr>
</tbody>
</table>

* Value (Mean ± SE)

Table 6. Analysis of variance of the data presented in Table 5 showing the total serum glyceride content in different breeds of goat.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>S.S.</th>
<th>M.S.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between genetic group</td>
<td>2</td>
<td>0.074</td>
<td>0.037**</td>
</tr>
<tr>
<td>Error</td>
<td>21</td>
<td>0.208</td>
<td>0.009</td>
</tr>
</tbody>
</table>

** Significant at 1% (P<0.01) level.
**Total serum cholesterol:**

The total serum cholesterol content of different breeds of goats are presented in Table 7. The analysis of variance of this data is presented in Table 8. The Black Bengal and its crosses (BTB and BS) contain (3.35 ± 0.29), (3.24 ± 0.29) and (3.36 ± 0.32) mML$^{-1}$ of total serum cholesterol respectively. The result did not show any significant difference between groups BS (Black Bengal x Sirohi) followed by BB (Black Bengal) and BTB (Black Bengal x Beetal) was observed such difference in cholesterol activity is clearly evidenced by Fig 4. as indicated by CD Test.

**Total phospholipid:**

The result on phospholipid content in serum are presented in Table 9. The analysis of variance of this data is shown in Table 10. The Black Bengal (BB) and its crosses BTB (Black Bengal x Beetal) and BS (Black Bengal x Sirohi) contain (1.269 ± 0.270), (1.080 ± 0.300) and (1.314 ± 0.426) gL$^{-1}$ of total serum phospholipid respectively. The result showed no significant difference in serum phospholipid content between groups, Black Bengal (BB) and its crosses Black Bengal x Beetal (BTB) and Black Bengal x Sirohi (BS) But non-significant higher value in Black Bengal x Sirohi (BS) followed by Black Bengal (BB) and Black Bengal x Beetal (BTB) was observed through CD Test, and is clearly evidence by Fig 5.

**MINERAL:**

**Serum sodium (Na$^+$):**

Data obtained on sodium level in serum of different breeds of goats are presented in Table 11. The analysis of variance of this data is presented in Table 12. The Black Bengal and its crosses, Black Bengal x Beetal (BTB) and Black Bengal x Sirohi (BS) contain (129 ± 5.254), (127 ± 7.911) and (137 ± 5.657) mML$^{-1}$ of sodium level in serum respectively. The result showed no significant difference in sodium level in serum among different breeds but the non-significant higher value in BS (Black Bengal x Sirohi) followed by BB (Black Bengal) and BTB (Black Bengal x Beetal) was clearly evidenced by Fig.6.
Table: 7. The values* of total serum cholesterol (mML$^{-1}$) of different breeds of goat.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Breeds</th>
<th>Total Serum cholesterol</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Black Bengal</td>
<td>3.35 ± 0.29</td>
</tr>
<tr>
<td>II</td>
<td>Black Bengal x Beetal</td>
<td>3.24 ± 0.29</td>
</tr>
<tr>
<td>III</td>
<td>Black Bengal x Sirohi</td>
<td>3.36 ± 0.32</td>
</tr>
</tbody>
</table>

* Value (Mean ± SE)

Table: 8. Analysis of variance of the data presented in Table 7 showing the total serum cholesterol content in different breeds of goat.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>S.S.</th>
<th>M.S.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between genetic group</td>
<td>2</td>
<td>0.01</td>
<td>0.005$^{NS}$</td>
</tr>
<tr>
<td>Error</td>
<td>21</td>
<td>1.6</td>
<td>0.076</td>
</tr>
</tbody>
</table>

NS: Non-significant.
Table: 9. The values* of total serum phospholipid (gL⁻¹) of different breeds of goat.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Breeds</th>
<th>Total Serum phospholipid</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Black Bengal</td>
<td>1.269 ± 0.270</td>
</tr>
<tr>
<td>II</td>
<td>Black Bengal x Beetal</td>
<td>1.080 ± 0.300</td>
</tr>
<tr>
<td>III</td>
<td>Black Bengal x Sirohi</td>
<td>1.314 ± 0.426</td>
</tr>
</tbody>
</table>

* Value (Mean ± SE)

Table: 10. Analysis of variance of the data presented in Table 9 showing the total serum phospholipid content in different breeds of goat.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>S.S.</th>
<th>M.S.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between genetic group</td>
<td>2</td>
<td>0.004</td>
<td>0.042&lt;sup&gt;NS&lt;/sup&gt;</td>
</tr>
<tr>
<td>Error</td>
<td>21</td>
<td>3.51</td>
<td>0.167</td>
</tr>
</tbody>
</table>

NS: Non-significant.
Table: 11. The values* of total serum sodium (mM L⁻¹) of different breeds of goat.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Breeds</th>
<th>Total Serum sodium</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Black Bengal</td>
<td>129 ± 5.254</td>
</tr>
<tr>
<td>II</td>
<td>Black Bengal x Beetal</td>
<td>127 ± 7.911</td>
</tr>
<tr>
<td>III</td>
<td>Black Bengal x Sirohi</td>
<td>137 ± 5.657</td>
</tr>
</tbody>
</table>

* Value (Mean ± SE)

Table: 12. Analysis of variance of the data presented in Table 11 showing the sodium level in serum of different breeds of goat.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>S.S.</th>
<th>M.S.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between genetic</td>
<td>2</td>
<td>428.52</td>
<td>214.26 NS</td>
</tr>
<tr>
<td>group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>21</td>
<td>6842.97</td>
<td>325.86</td>
</tr>
</tbody>
</table>

NS: Non-significant.
Potassium ($K^+$):

Data obtained on the level of Potassium in serum of different breeds of goats are presented in Table 13. The analysis of variance of this data is presented in Table 14. The Black Bengal (BB) and its crosses Black Bengal x Beetal (BTB) and Black Bengal x Sirohi (BS) contain ($4.31 \pm 0.519$), ($4.58 \pm 0.316$) and ($4.90 \pm 0.447$) mML$^{-1}$ of potassium level in serum respectively. The result showed no significant difference in potassium level in serum among Black Bengal and its crosses. The higher value in BS (Black Bengal x Sirohi) followed by BTB (Black Bengal x Beetal) and BB (Black Bengal) was observed. Such difference in potassium level in serum is clearly evidence by Fig 7. The other all values of potassium is appeared to be low in Black Bengal and its crosses as compared to sodium (Table 11, 13 and Fig 6, 7).
Table: 13. The values* of total serum potassium (mM L⁻¹) of different breeds of goat.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Breeds</th>
<th>Total Serum potassium</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Black Bengal</td>
<td>4.31 ± 0.519</td>
</tr>
<tr>
<td>II</td>
<td>Black Bengal x Beetal</td>
<td>4.58 ± 0.316</td>
</tr>
<tr>
<td>III</td>
<td>Black Bengal x Sirohi</td>
<td>4.90 ± 0.447</td>
</tr>
</tbody>
</table>

* Value (Mean ± SE)

Table: 14. Analysis of variance of the data presented in Table 13 showing the potassium level in serum in different breeds of goat.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>S.S.</th>
<th>M.S.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between genetic group</td>
<td>2</td>
<td>1.39</td>
<td>0.70 NS</td>
</tr>
<tr>
<td>Error</td>
<td>21</td>
<td>31.61</td>
<td>1.51</td>
</tr>
</tbody>
</table>

NS: Non-significant.
DISCUSSION

Total lipid:

Lipid is applied as a group of naturally occurring substances which play a vital role in animals. It serves as a stored fuel in the body which provides the energy whenever it is required. Lipid also plays an important role as an insulation to maintain the body temperature. The present observation of total serum lipid of goat is presented in Table-1 and Fig 1. The Black Bengal (BB) and its crosses (BTB & BS) appears to have differences in total lipid content (Fig 1) as observed by Tsunoda et al. (1990) who reported significant variation in total lipid between the breed (phenotype). The present finding appears to have similar the observation of Bas et al. (1980) who found significant individual variation in total serum lipid in goat. The concentration of total lipid in serum was lower than the values reported by Pugliese et al. (1982) and Castro et al. (1977). However analysis of variance didn’t show significant differences in total serum lipid (Table 2). Although our present observation was in confirmity as reported by Black More et al. (1988).

Total fatty acids:

The major component of fatty acids are existing in esterified in tissue and cell. They are mainly associated with glyceride which provide stored energy and insulation. The gonads contain high concentration of poly unsaturated fatty acids which is of prime important of reproductive function. Some of the fatty acids are available in serum in the transport form which remain temporarily bound to other substances like proteins.
The finding of total serum fatty acids is represented in Table 3 and analysis of variance of this Table shown in Table 4. The result of serum fatty acids contents appeared to be more in Black Bengal followed by Black Bengal X Beetal and Black Bengal X Sirohi (Fig 3) while as reverse is true for serum glycerides (Table 5) showing low serum glycerides for Black Bengal. (This is clear cut indication showing high content of free fatty acids which remains in free form indication more value during present finding). These may be utilized for energy purpose in Black Bengal (BB) as compared to BB x BTB and BB x BS.

However, analysis of variance didn’t show significant difference between these groups. But Fuhrmann et al. (1988) shows variation between heifer and cows where, cows has higher fatty acid content than heifer. More(2006) reported 0.55m molL⁻¹ of free fatty acids for ruminant. But the present finding of serum fatty acid is similar to observation of Fuhrmann et al. (1988) as in case of heifer.

**Total serum Glycerides:**

Glycerides provide stored energy. Some amount of glyceride remains in dynamic stage in blood. The serum glyceride level is presented in Table -5 and its analysis of variance in Table-6.

The analysis of variance showed highly significant difference (P<0.01) between genetic group. The level in Black Bengal was found to be low as compare to Black Bengal x Beetal (BTB) and Black Bengal into Sirohi (BS). However the values between Black Bengal x Beetal (BTB) and Black Bengal x Siroh(BS) didn’t show differences statistically. These pattern of glyceride
profile appeared to be increasing trained in Black Bengal (BB) followed by BTB & BS.

Such finding is clearly evidenced in Fig -3. Erdos and Fontaine (1978) reported variation in serum lipid due to breed, age and sex in avian species. Hugi and Blum (1997) studied includes that in calves the cholesterol concentration increased transiently with age but triglycerides didn’t show a consistent change. Braun Wald (1995) and Klenveld (1996) reported that in human there was significant increase in concentration of serum cholesterol and triglycide in advanced age. However, Sharma et al. (1990) didn't show variation due to sex differences in lower age group of chegu goat. But our present finding increasing glycerides appeared to be similar to earlier worker (Erdos & Fontaine 1978).

The present finding of glycerides is appeared to have negative co-relation with serum fatty acids Table-3 indicating more free fatty acids and low serum glycerides in all the genetic groups (Fig 2 & Fig 3). This showed that glyceride formation depend upon free fatty acid content in serum indicating degree of esterification for glyceride formation or utilization of fatty acids for energy purpose through β- oxidation cycle etc. These changes appeared to be due to Metabolic need and physiological activities in these genetic groups (BB, BTB x BS). The above finding is in conformity with the observation of Nazifi et al. (2002) in case of Iranian male goats.

**Serum Cholesterol:**

Cholesterol play role as a precurssor of steroid and bile salts etc. Besides this, it serves as structural lipids and main constituents of cell
membrane. The regulation of serum cholesterol level depend not only the rate of synthesis but also upon the rate of degradation and excretion of cholesterol in liver. (Oser; 1979). The level of cholesterol is presented in Table-7 and ANOVA in Table-8. The result reveal no significant difference among all genetic groups (BB, BTB and BS) as evidence from analysis of variance (Fig.4). The above finding is similar as reported by More (2006) in case of ruminant. The concentration of serum cholesterol in Iranian male goats was higher than the value reported by pugliese et al.(1982) and lower than the value in cows. Bartley (1989). Our present finding confirm the observation of Oshiro et al. (1979) who reported that the concentration of serum cholesterol in goats was lower than the value in cows. This finding confirms the high value of total cholesterol in lactating cows (Grimoldi et al. 1988) as compared to three genetic groups BB, BTB and BS.

**Total Phospholipids:**

Phospholipids are esters of fatty acids with glycerol containing a nitrogen base and an esterified phosphoric acid. It acts as carrier of inorganic ions across the membranes. The level of serum phospholipid is shown in Table 9 and analysis of variance in Table 10. In present study non-significant differences were observed between genetic groups but some decreased value as observed in BTB groups (Fig 5). The present value was similar to the finding of Grimoldi et al. (1988) in case of lactating cow. Slightly low value in BTB groups might be due to physiological nature of this groups which are mainly used for good quality meat purposes. The phosphorous is the only inorganic minerals which determine the quality of meat which may be retained
with muscle resulting into low serum phospholipid it revels having a good quality meat of this genetic group (BTB) during present investigation.

**Minerals**

**Sodium and Potassium:**

Macro and micro minerals shown to have physiological role in one or more species of animals. Among the macro minerals sodium in principal serve extra cellular cat-ion and potassium are involved in electrolyte balance. If also server as the mono-valent cat-ion to balance an-ion intra-cellularly as part of the sodium-potassium pump physiological mechanism. It is largely associated with chloride bi-carbonate in regulation of acid base equilibrium. It maintains the osmotic pressure of the body fluid. There by protecting the body against excessive fluid loss and maintains the normal water balance and distribution. Sodium ion is involved in initiating and maintaining the heart beat. Even the electro cardio-gram of potassium deficient goats showed reduced heart rate and increased eleetro-cardial intervals.

The result of present finding is presented in Table - 11 and the analysis of variance of this data is presented in Table - 12. The result did not showed significant difference among the different genetic groups of animal. Several workers (Parek *et al*. 1986, Bhat *et al*. 1987) reported no significant difference between the breed which support our present finding. Khan *et al*. (1983) Mangal *et al*. (1988) Mert *et al*. (1989) reported higher sodium level in blood than potassium as evidence during present investigation (Fig 6 and Fig 7). Kumar *et al*. (1987) measured frequency distribution of blood Potassium concentration and reported bimodal which was controlled by Z-gene.
Bhat *et al.* (1987) reported significant difference in sodium potassium level between the breeds while Cappa *et al.* (1990) investigated significant difference in sodium and potassium level during lactation. Our present findings are in conformity with observation of Khan *et al.* 1983, Mangal *et al.* 1988 and Mert *et al.* 1988 who observed low potassium level and high sodium level in serum.
SUMMARY AND CONCLUSION

Summary:

The genetic make up and environmental effect differentiate the different breeds of goat. It is expressed by the synthesis and degradation through metabolism of different substrate and exchange of metabolites. The study on these metabolites and as well as minerals were under taken to compare variation as well as breeds characteristics of Black Bengal (BB) and its crosses, Black Bengal X Beetal (BTB), Black Bengal X Sirohi (BS).

Blood samples were collected from experimental animals from three groups i.e. Gr. I (BB), Gr. II (BTB) and Gr. III (BS) from jugular vein. Serum was obtained and stored till analysis was over. Among the biochemical constituents total serum lipid was appeared to be higher \( (2.974 \pm 1.1448) \text{ gL}^{-1} \) in BTB followed by BB and BS. Such variation might be due to less water retention in muscle as the amount of water in lean meat is greater than fat meat. Total fatty acids content in serum were found to be more in BB \( (0.1358 \pm 0.0129) \text{ mML}^{-1} \) with respect to BTB and BS. It might be due to variation in lipid metabolism in which these molecules are utilized for energy purpose in ruminants.

Glycerides appears to be significantly low \( (p < 0.01) \) in BB \( (0.123 \pm 0.006) \text{ mML}^{-1} \) as compared to BTB and BS such finding affects the fat deposition in the body tissues as confirmed by indicating estirification with free fatty acids.
Total serum cholesterol reveal no significant difference among three genetic group.

Like cholesterol, total serum phospholipid did not showed variation, which are mainly associated as a structural lipid. Sodium and potassium level in serum of BB and its crosses (BTB and BS) were not found significant different. However, potassium level were found to be low as compared to sodium among all crosses (BTB and BS).
Conclusion:

1. Based on the present findings, Black Bengal and its crosses can be characterized biochemically as per neutral lipids specially fatty acids and glycerides.

2. Serum mineral specially sodium and potassium level can not be used for characterization biochemically. The detail biochemical characterization of fatty acids and glycerides specially from muscles are suggested for future studies in these species, which may be useful for meat quality.
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APPENDIX

COLOURING REAGENT OF TOTAL CHOLESTEROL:

15 ml of concentrated sulphuric acid was taken in a dry, 100 ml measuring cylinder. 1.0 ml of ferric chloride solution (10gm/100ml aldehyde free glacial acetic acid) was added and agitated well. Finally the volume was made 100 ml with concentrated H$_2$SO$_4$ and mix properly before use {1% ferric chloride 10% in aldehyde free glacial acetic acid v/v}.

REAGENT USED FOR ESTIMATION OF TOTAL SERUM FATTY ACID:

i) Chloroform (A.R)

ii) Copper reagent :- 9 ml of aqu. 1M Triethanolamine + 1vol; 1N Acetic acid + 10 vol. of 6.45% (w/v) Cu(NO$_3$)$_2$ ; H$_2$O (A.R) (i.e 9ml+1ml+10ml) = 20 ml

iii) Diethyl Dithio Carbamate Reagent :-

(0.1% w/v) A.R in redistilled butan-2-ol

Standard fatty acid (10-100 µM ) per 5ml chloroform (A.R) used

i) Palmitic acid

ii) Stearic acid
REAGENT USED FOR ESTIMATION OF GLYCERIDES:

i) Hexane : either (1:1 v/v)

ii) Alcoholic KOH (0.1 N)

iii) H$_2$SO$_4$ (0.4 H$_2$SO$_4$)

iv) Sodium Metaperiodate (0.5N)

v) Sodium Bisulphite (20%) & Sodium Arsenite (0.5M)

vi) Chromotropic acid (freshly prepared dissolved 0.5 mg of chromotropic acid in 10 ml of distilled water and 250 ml of 66% sulphuric acid)
Fig. 1 Showing the concentration of total lipid content in serum of goats

Group I (BB)  Group II (BTB)  Group III (BS)