PHYSIO-BIOCHEMICAL EVALUATION OF BROILER CHICKEN FED WITH PROCESSED FISH WASTES

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Thesis submitted in partial fulfilment of the requirement for the degree of

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DECLARATION

I hereby declare that the thesis entitled **PHYSIO BIOCHEMICAL EVALUATION OF BROILER CHICKEN FED WITH PROCESSED FISH WASTES** is a record of research work done by me during the course of research and this thesis has not previously formed the basis for the award of any degree diploma fellowship or associateship or other similar title of any other University or Society

Mannuthy
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Certified that the thesis entitled **PHYSIO BIOCHEMICAL EVALUATION OF BROILER CHICKEN FED WITH PROCESSED FISH WASTES** s a record of research work done independently by **DARSANA M G** under my guidance and supervision and that it has not previously formed the basis for the award of any degree diploma fellowship or associateship to her

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Darsana M. G.

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Introduction

1 INTRODUCTION

Indıa has made tremendous progress n broıler product on ın the last two decades Chıcke ı meat productıon ın Indıa has ıncreased from 1 08 mıllıon metrıc tonnes ın the year 2000 to 1 60 mıllıon metıic ton ıes dur ng 2004 (FAO 2005) Indıa contrıbutes 2 39 per cent of world s total poultry meat p oductıon and ıs the e ghth largest producer of bro ler neat ın the world The poultıy sector provıdes about 2 per cent of the total gross domest c pıoduct (GDP) of Indıa The per capıta avaılabılıty of poultry meat has ıncreased from 600 g n 1992 to 1 3 kg ın 2002 (Poultry Internatıonal Execut ve Guıde 2004)

Poultry ındustry ın Indıa started as a backyard actıvıty and ın the past three decades ıt has undergo ıe a revolut ona y change In the comıng years due to urbanızatıon and r s ng ncome the affordabılıty of chıcken meat and eggs would ıncrease leadıng to a greater demand for poultry products In 1991 poultry accounted for 16 per cent of the total anımal proteın consumpt on and ın 2000 ıt rose to 36 per cent In the overall market for poultry products Indıa ıs posıtıoned 17 ın World Poultry Productıon

Fısh farmıng produces large amounts of by products durıng ts commercıal processıng These by products are a potentıal source of pollut on f dumped at sea or dıscarded offsl ore But by products from the fishıng ındustry and fish farmıng have been shown to be a valuable an mal proteın source ın an mal feed ıf converted ınto fish sılage

Fısh meal s an ımpo tant ıngred ent of broıler feed Its prote n qualıty as well as potency of unıdentıfied growth factors varıes greatly Broıler dıets contaın 20 to 23 per cent crude proteın and of thıs 4 5 to 5 5 per cent ıs constıtuted by anımal proteın maınly fish meal The cost of productıon of one kg of drıed fish ıs approximately Rs 15 But the cost of production of one kg of acid silage (fish waste) is Rs 4 25 while that of sur mi waste powder is negligible Since the availability of certain amino acids are l mited in vegetable protein supplements it is necessary to use animal protein sources in poultry feeds But due to the high cost and low availability of f sh meal alternative sources of animal protein in the diet are to be explored Instead of the usual unsalted dried fish unconventional fish by products are used now a days due to high price of raw fish In India the processing wastes generated by many fisl processing centres cause a problem of their disposal Hence conversion of this waste into other by products which could be included in the poultry ration is an alternative Acid silage and surimi waste powder are two such products developed from the waste obtained during the processing of the fish Japanese thread fin bream (*Nemipterus japonicus*) by the Central Institute of Fisheries Technology (CIFT) Koch

The present study is planned to assess whether the fish by products namely acid silage (fish waste) and surimi waste powder could be used as alternative source of animal protein replacing dried fish/fish meal in bro ler ration by investigating its physiological and b ochemical parameters in broiler chicken

Review of literature

2 REVIEW OF LITERATURE

The most commonly used organic acids for acid silage preparation were propionic acetic and fo m c ac ds Among these formic acid is one of the organic acids widely used n the production of acid silage due to its property of preserving the silage and increas ng the shelf life upto one year at ambient temperature of the tropical countr es A three per cent by weight of 98 per cent formic acid was added to the well ground fish mince as a preservative (Tatterson and Windsor 1974)

James *et al* (1976) at the Natural Resources Institute London conducted extensive feeding trials in United K ngdom and various countries in Africa and Asia and conclusively established that formic acid preserved s lage is a sat sfactory substitute for fish meal n poultry diet

Kompiang *et al* (1979) worked out the chemical composition fermentation characteristics and nutr t onal value of microbial fish s lage They observed that during a three week feed ng period the growth rate of the ch cken fed with diets containing silage up to eight per cent was similar to that of the birds fed with standard fish meal conta n ng rat on

Feeding tr als conducted in Thailand by Pong Pen *et al* (1979) demonstrated that growth of ch cken fed on d et having five per cent s lage was comparable to that of ch cken fed on fish meal the latter being marginally super or to growth of silage fed chicken

Short term feeding trials in very young pigs in Indones a and long term feeding trials n growing pigs in India (Rangkuti *et al* 1980 Anon 1976 and 1977) conf rmed that fish silage could serve as an active protein supplement for pigs without any ill effects The study conducted also revealed that feed efficiency and weight gain in pigs fed on silage at 20 per cent level in the diet were comparable to those pigs fed on fish meal (six per cent) both diets being at isoprotein level

Raa and Gildberg (1982) observed that fish silage made by acid addition or lactic acid fermentation could be used to replace the traditional diets of soya flour or fish meal in feeding various farm animals like pigs calves fox mink sheep beef cattle and poultry It was also observed that the performance of poultry broilers had been consistently poor when fed on fish silage may be due to thiamine deficiency use of spoiled raw materials and oxidation of fish lipids

Johnson *et al* (1985) evaluated the nutritional quality of two types of fish silage for broiler chicken They demonstrated that with appropriate precautions in the preparation and handling of fish before ensiling fish silage could be incorporated into nutritionally balanced diets for broiler chicken without detrimental effects on growth or carcass taste Live weight and live weight gain were more for birds fed with fish silage than that of birds fed with normal fish meal diet The live weight obtained for birds fed with normal fish meal for 6 weeks was 1737 g and for birds fed with fish silage ranged from 1808 to 1896 g

Krogdahl (1985a) used fish silage as a protein source for layer type chicks and hens He observed that egg production and feed efficiency were not affected by diets containing 20 per cent of protein from concentrated viscera silage

Krogdahl (1985b) evaluated fish viscera silage as a protein source for meat type chicken He reported that all the observed characteristics of broiler performance viz weight gain and slaughter yield were influenced positively by fish viscera silage

Bowes *et al* (1989) compared the serum biochemical profiles of male broilers with female broilers and white leghorn chickens They reported that in four week and six week old normal broiler chicken the total serum protein concentration were 2 56 and 2 65 g/dl respectively serum album n concentration were 1 29 and 1 37 g/dl respect vely and serum globulin concentration were 2 15 and 1 89 g/dl respectively At fourth week and sixth week the AST values were 184 and 254 U/l respectively while the total serum cholesterol concentrat ons were 4 23 and 3 23 mmol/l respectively There was significant difference between the control and experimental groups in the values of total protein albumin globulin potassium calcium and serum cholesterol concentrations but no significant difference was observed in the case of AST sod um and magnesium

Myer *et al* (1990) opined that the inclus on of scallop viscera silage at a dietary level of 24 per cent d d not significantly influence average daily gam or average daily feed intake in pigs They concluded that waste scallop viscera could be used as a high protein feed stuff in swine diets The daily ga n valı e obtained for zero per cent scallop v scera added ration was 0 86 kg while that of 24 per cent added was 0 87 kg The daily feed intake values obtained for zero per cent and 24 per cent scallop viscera added rat on were 2 69 and 2 66 kg respectively

Stoner *et al* (1990) conducted two trials to evaluate a select menhaden fish meal (SMFM) as a protein source in starter diets for three week old weaned pigs The diet containing 10 per cent dr ed whey and 4 per cent SMFM resulted in growth and performance s milar to that from the diet containing 20 per cent dr ed whey and zero per cent SMFM They indicated that 4 per cent SMFM could replace half the dr ed whey in a 20 per cent dried whey starter diet and concluded that nenhaden fish meal could be used as the major prote n source n starter diet for pigs The daily feed intake of pigs of zero to t vo weeks fed 4 per cent SMFM and 10 per cent dried whey was 290 g and of those fed zero per cent SMFM and 20 per cent dried whey was 289 g

The effect of feeding sardine fish oil on the metabolism of lipoproteins was studied in rats by Anil *et al* (1992) Rats fed diets conta ning 10 per cent sardine expressed a significant decrease in the total cholesterol triglycer des VLDL in serum in fish o l fed rats They concluded that the act vity of lipoprotein lipase in adipose tissue and aorta was sign f cantly higher in rats fed sard ne oil which caused an increased cleara ce of tr glycer de r ch lipoproteins from circulat on

Espe *et al* (1992) subst tuted fish silage protein for fish meal protein n White Leghorn ch cken They observed that chicken fed w th f sh s lages in graded amounts showed the same or better weight ga ns and feed eff c enc es compared with chicken fed with d etary f sh prote n as f sh meal

Tuitoek (1992) carr ed out tr als to nvestigate the potential of small pelagic fish *(Rastriobola argentii s)* locally referred to as omena as a protein supplement for pigs The control group was given soyabean meal Average daily ga ns da ly feed intakes were similar between the two d etary treatments and concluded that ***Rastriobola argent us*** s a potent al prote n supplement for p gs

Connor *et al* (1993) studied the effects of n 3 fatty acids from fish oil on plasma lipoproteins and hypertr glycer dem c patients They found that dietary n 3 fatty acids from f sh and fish o l had profound hypolipidemic effects in normal subjects and in hypertr glycer demic patients with hyperlipidemia In metabolic exper ments reductions occurred n plasma triglycerides plasma total cholesterol very low dens ty l poproteins chylomicrons and low density lipoproteins They opined that the use of fish oil supplements could be regarded as a pharmacologic therapy particularly effective in severe hypertriglyceridemic states and that a life long diet rich in fish might be protective against atherosclerosis The hypolipidemic effects of n 3 fatty acids coupled w th the r ant thrombotic actions appeared to have an important potent al role in the control of coronary heart disease and other atherosclerotic d sorders

Fagbenro *et al* (1994) used dry d ets contain ng varying levels of dried fermented fish s lage and soya bean blend as replacement for 25 50 or 75 per cent fish meal protein in aqua culture feeds There was no significant difference in the final body weight between control and treatment groups Results showed that a well balanced dry feed based on co dried fermented silage was as efficient in supporting growth as a dry fish meal based d et and that it represented an alternat ve to fish meal in utilizing waste or trash fish under sized or low value fish as protein feed stuff for aqua culture species

Rose *et al* (1994) compared the nutritional value of naturally fermented fish silage with formic ac d fermented fish silage in pigs They found out that the feed intake of the p gs given tl e naturally fermented silage were 12 per cent greater than those given the acid silage Poor flavour characteristics of the fish silage probably reduced the voluntary feed intake of the pigs and resulted in poor productive performance

Fagbenro and Jauncey (1995) studied the growth and protein utilization by juvenile cat fish fed with fish silage Fish silage prepared from lactic acid fermentation of whole tilapias 5 % sugar beet molasses and 2 % *Lactobacillus plantarum* were used They found that the haematocr t and haemoglobin contents showed no sıgnıficant dıffere ces among the sılage treatments They obtaıned mean values for PCV and Hb as 30 8 % 8 6 g / 100 ml respect vely They concluded that fermented fish – sılage co dr ed wıth proteın feedstuffs was a suıtable proteın supplement wıthout affectıng feed efficıency growth or health

Prawn process ng wastes upon ensılatıon contaıned value added nutrıents lıke carotenoıd p gments and n 3 poly unsaturated fatty acıds wh ch are released by ensılatıon but are otherw se dıff cult to ext act even by solvents (Guıllou *et al* 1995)

Kasat and Baghel (1995) stud ed the proteın utılızatıon ın broılers offered ten ısocaloric (2900 K Cal ME/kg) and ısonıtrogenous (23 per cent CP) d ets contaınıng dıfferent levels (2 2 5 3 3 5 4 4 5 5 5 5 6 and 6 5%) of fish meal proteın They concluded that most effic ent proteın utılızatıon was observed ın broılers offered 23 per cent CP dıet conta nıng 6 per cent fish meal proteın along wıth vegetable proteın supplement

Rosenfeld *et al* (1997) conducted a study to measure the effect of substıtutıng dıfferent levels of shrımp meal for soyabean meal ın broıler dıets Study revealed that carcass we ght ıncreased sıgnıficantly by 12 1% wl en shr mp meal was substıtuted 100% for soyabean meal They concluded that shrımp meal used could partıally or totally replace soyabean meal ın bro ler dıets wıthout negatıvely affect ng performance or carcass qualıty

Peebles *et al* (1997a) stud ed the effects of addıtıon of lard to the starter dıets ın broıler chıcken up to s x weeks of age They observed that as the age advanced the body weıght and haematocrıt values of the bırds ıncreased and also body weıght of male chıcken were normally more than female chıcken The VPRC of fourth week and sixth week old normal broiler chicken were 26 50 % and 30 40 % and was similar to experimental groups According to their study the total plasma protein concentration in normal broiler chicken of four five and six weeks of age were 3 96 4 05 and 4 08 g/dl respectively which was similar to that of the experimental groups

A study was conducted by Peebles *et al* (1997b) to assess the effects of addition of lard to starter diets in broiler chicken up to six weeks of age They found that in normal broiler chicken from fourth to sixth week of age the concentration of triglycerides ranged from 103 to 164 mg/dl The serum HDL concentration ranged from 78 to 88 mg/dl which was significantly d fferent from the experimental groups VLDL concentration ranged from 21 to 33 mg/dl and total serum cholesterol concentration ranged from 115 to 122 mg/dl and all the values were significantly different from the control groups

Razdan *et al* (1997) studied the response of feed ng ch tosan and pectin in two week old broiler chicken They reported that in the plasma of two week old normal broiler chicken the tr glyceride HDL and total cholesterol concentration were 0 34 2 89 and 7 78 mmol/l respectively There was no signif cant difference between control and experimental groups in tr glyceride and HDL concentrations but total cholesterol showed a significant difference

Palod and Baghel (1998) undertook a study to find the effect of feeding varying levels of fish meal protein (FMP) on carcass traits of broilers They observed that 5 per cent FMP along with soyabean meal was best for efficient carcass yield They also commented that the mean value of giblet weight for the 5 % group was 51 24 g

Hammoumi *et al* (1998) conducted feeding trials in broilers using fermented fish waste The nutritional assays showed a net increase in the broiler weight relatively to the control diet

An investigation was conducted by Kanagaraju (1998) to assess the influence of phytase on phosphorous utilization in broilers The mean body weight obtained for normal broiler chicken of four to eight weeks of age ranged from 703 to 1480 g and the mean values of giblet weight of normal broiler chicken of eight weeks of age was 123 g They also reported that the mean serum Ca concentration at sixth week of age was 11 03 mg % According to the study there was no significant difference between the control and experimental group in the case of body weight but there were significant differences in case of giblet weight and serum Ca

Stadelman *et al* (1988) opined that in raw broiler chicken meat the protein content was 21 39 g the fat content was 1 65 g and the ash content was 0 98 g per 100 g edible portion They also observed that the cholesterol content of poultry meat was 75 mg per 100 g edible portion

Castillo *et al* (1999) investigated the effect of dietary fish oil in the cholesterol and arachidonic acid levels in chick plasma and VLDL The study showed that supplementation of 10 per cent menhaden oil to the chick diet for seven days produced a significant hypocholesterolemia and hypotriglyceridemia Total cholesterol and triacylglycerol contents decreased in HDL All chemical constituents of VLDL significantly decreased after the first week of menhaden oil supplementation to the diet

Imaeda (1999) characterized serum enzyme activities and electrolyte levels in 6 week old broiler chickens and noted that the mean Na and K values of the normal control bırds were 158 ± 4 and 5 8 ± 0 5 mmol/l respectıvely The mean SGOT value was 128 ± 3 U/l

Kjos *et al* (1999) studıed the effects of dıetary fish sılage and fish fat on growth performance and carcass characterıstıcs of growıng and finıshıng pıgs They found no negatıve effects on growth performance and carcass qualıty

Vızcarra Magana *et al* (1999) conducted a study on the nutrıtıonal evaluatıon of sılage prepared from tuna fish wastes ın bro lers and found that the drıed product obtaıned could be successfully ıncorporated ın broıler dıets at levels up to 15 per cent wıthout adverse effects The average we ght gaın on usıng 0 5 10 and 15 % sılage ın the dıet were 519 83 ± 16 43 541 7 ± 6 8 517 2 ± 16 and 499 3 ± 15 5 g and the average feed ıntake were 757 ± 163 809 ± 19 26 749 ± 32 3 and 794 ± 13 05 g respectıvely

Balasubramanıan (2000) studıed the ınfluence of mıcrobıal phytase on nutrıent utılızatıon ın broıler chıcken The mean body weıght obtaıned for normal broıler chıcken of four to eıght weeks of age ranged from 1030 to 1832g and the mean gıblet weıght of chıcken of sıx week and eıght week of age were 111 94 and 159 58g respectıvely The mean serum Ca concentratıon at sıxth week of age was 12 03 mg% accordıng to the study All the values were stat st cally comparable to those of the experımental groups

Proteın qualıty of shrımp waste meal (SWM) was assessed ın a balanced experıment wıth 30 rats (Fanımo *et al* 2000) The rats were fed four dıfferent 10 per cent proteın dıets (consıstıng of) namely fish meal SWM SWM + lysıne + methıonıne SWM + methıon ne and a n trogen free basal dıet Shrımp waste meal reduced the relatıve weıghts of lungs lıver and ıntestınes Rats fed wıth SWM dıet had lower plasma protein and albumin Plasma Na and K were increased with amino acid supplementation of SWM diet The results showed that the protein quality of SWM was inferior to that of fish meal but the supplemented amino acids in SWM diets improved the quality of the protein

Puvadolpirod and Thaxton (2000) studied the effect of stress in 5 week old chicken They observed that the mean values of RBC count and WBC count of normal control group were 2 01 ± 0 08 ($\times 10^6/\mu l$) and 11 31 ± 0 09 ($\times 10^3/\mu l$) respectively which were similar to the experimental groups They also found that the mean values of plasma cholesterol triglycerides and HDL for the normal control group were 87 38 ± 3 85 94 88 ± 14 44 and 63 50 ± 3 09 mg/dl respectively which were lower than the values in the experimental groups

Anil (2001) conducted a study to assess the effect of sodium sulphate supplementation in broiler diet and mean values obtained in normal broiler chicken for the total serum protein concentration at eighth week of age was 4 97 g % The giblet weight of normal birds at eight weeks of age was 159 g The mean body weight at fourth and sixth weeks of age ranged from 1012 to 1840 g There was no significant difference in the values between control and experimental groups

Kadari (2001) investigated the effect of probiotic supplementation on the performance of broiler chicken up to eight weeks of age The body weights of normal broiler chicken from fourth to eighth weeks of age ranged from 924 to 2092 g In eight week old normal broiler chicken the serum protein concentration was 4 16 g/dl The giblet weight of eight week old broiler chicken was 73 43 g The growth of vital organs depends on the nutritional status of the birds (Bhosale and Rao 2001) All these values were statistically comparable with that of experimental groups

Kjos *et al* (2001) studied the effects of dietary fish silage and fish fat on the performance and egg quality of lay ng hens They observed that fish by products preserved as concentrated defatted fish silage could be fed as a part of the compound feed for laying hens In the study an inclusion level of 50 g/kg diet supplementing 12 per cent of the total prote n had no effect on egg production

Ngoan *et al* (2001) conducted feed ng trials to evaluate the effects of replacing fish meal (FM) with ens led shrimp by product (ESB) in a cassava root meal and rice bran based diet on the performance and carcass character stics of growing p gs The crude prote n of tl e FM was replaced with 0 50 or 100 per cent ESB The study revealed that animal growth performance and daily feed intake were significantly reduced by the inclusion of shrimp by products in the diets whereas carcass measurements were not signif cantly affected Daily weight gam of the pigs fed with 100 per cent FM d et and 50 per cent ESB diet were significantly higher than those fed with 100 per cent ESB diet They concluded that from economical as well as performance point of view ensiled shrimp by product could replace 50 per cent of the crude prote n of fish meal for growing pigs

Newman *et al* (2002) studied the effects of dietary n 3 and n 6 fatty acids on chicken metabol sm and found that the mean value of NEFA was 200 µmol /l for the normal control group fed w th f sh o l which was not significantly d fferent from the experimental groups fed with sunflower oil and tallow

Sands and Smith (2002) studied the effects of dietary manganese proteinate and chromium picolinate supplementation on NEFA in broiler chickens reared under thermoneutral condit ons They found that in normal control group of birds the NEFA concentration was 520 µmol/l which was similar to that of chromium pıcolınate supplemented group and was sıgnıficantly hıgher than manganese proteınate supplemented group

The effects of copper sulphate on meat cholesterol of broıler chıcken were ınvestıgated by Skııvan *et al* (2002) They observed that ın sıx weeks old normal broıler chıcken tl e meat cholesterol was 62 50 mg/100g and was sıgnıficantly hıgher than the experımental groups

Stephenson (2002) observed that Hb VPRC TEC and TLC reflect the overall health status of an an mal Iheukwumere and Herbert (2003) assessed the physıologıcal responses of fouı week old broıler chıckens to quantıtat ve water restrıctıons They noted that the mean values of VPRC Hb and serum ALT ın normal control group of bırds were 38 % 13 g % and 22 10 U/l respectıvely

Ashwell and McMurty (2003) conducted studıes to determıne ıf metformın possess hypoglycemıc and anorect c effects ın broıler chıcken They reported that the concentratıon of NEFA ın four week old normal broıler chıcken was 206 µmol/l A sıgnıficant dıfference was not ced between the control and experımental groups

Maıgualema and Gernat (2003) measured the effect of substıtutıng elevated levels of tılapıa by product neal for soyabean meal ın broıler d ets The results showed that chıcks fed upto 50 per cent level tılapıa by product meal had sıgnıficantly hıgher body weıghts carcass weıghts feed consumptıon and ımproved feed conversıon as compared to those fed wıth soyabean meal

Reddy (2003) conducted a study on the antıoxıdant and hypolıp demıc effects of spırulına and natural caroteno ds ın broıler chıcken In four sıx and eıght week old normal broiler ch cken the mean VPRC values were 29 75 % 31 63 % and 29 63 % respectively while the mean RBC count were 3 04 3 09 and 2 9 ($\times 10^6$ / µl) The mean WBC count from fourth to eighth week ranged from 23 74 to 26 49 ($\times 10^3$ / µl) There was no s gnificant difference in the values between the groups

Islam *et al* (2004) conducted an experiment to study the haematological parameters in Fayoumi Assil and local chicken of different ages reared in Bangladesh They found out that erythrocyte numbers haemoglobin concentration and packed cell volume increased with the advancement of age in all the three breeds They observed that the mean values of haemoglobin VPRC and total erythrocyte count of local ch cken of one month of age were 7 73 ± 0 14 g % 27 73 ± 1 21 % and 1 70 ± 0 04 ($\times 10^6$/µl) and there was no significant difference in these values with that of the Fayoumi and Assil breeds

An investigation over a period of e ght weeks was carried out by Kollanoor (2004) to study the effect of d etary ron and supplementation of phytase on growth and mineral availability of broiler chicken The serum Ca Mg and Fe levels in six week old normal chicken were 11 89 mg % 1 79 mg % and 58 17 µmol/l respectively and the values were similar to the experimental groups

The effect of heat stress on production parameters and im nune responses of commercial laying hens was investigated by Mashaly *et al* (2004) They observed that the WBC count of normal laying hens increased as the age advanced and reported that the WBC count at 31 and 34 weeks of age were 3 50 and 5 50 ($\times 10^3$/µl) wh ch was sign ficantly different from the experimental groups

Reddy *et al* (2004) stud ed the ant oxidant and hypolipidemic effects of spirul na and natural caroteno ds n broiler chicken They observed that the mean values of blood super ox de dısmutase catalase reduced glutathıone and lıpıd peroxıdatıon for control group of b rds were 260 36 ± 77 63 U/g Hb 8 00 ± 1 34 k/g Hb 50 7 ± 2 41 nmol/ml and 3 65 ± 0 17 nmol/ml respectıvely and were sıgnıficantly dıfferent fro n the experımental groups They observed that the mean values of total l pıds and trıglycer des of normal control broıler chıcken were 543 07 ± 76 98 mg/dl and 97 28 ± 9 21 mg/dl respectıvely and were sıgnıficantly dıfferent from the experımental groups

An nvestıgat on was co ducted by Renjıth (2004) to study the effect of dıetary suppleme tat on of bakeı s yeast ın broıler chıcken up to eıght weeks of age The mean body weıght of the normal broıler chıcken of foı rth sıxth and eıghth weeks of age was 1118 1974 and 2584 g respectıvely The values were statıstıcally sımılar except for the fourth week ın whıch the body weıgl t of the control group was sıgnıficantly lower than that of exper mental groups The mean gıblet weıght of eıght week old normal broıler chıcken was 96 38 g whıch was sımılar to the experımental groups The normal bro ler ch cken of eıght weeks of age had a total serum proteın concentratıon of 3 3 g/dl and was sımılar to the experımental groups

Bunchasak *et al* (2005) ınvestıgated the effect of dıetary proteın on ımmune responses of layıng hens durıng peak productıon perıod They observed that the mean values of albumın globul n and albumın globulın rat o were 1 14 ± 0 16 g/dl 2 20 ± 0 40 g/dl and 0 60 ± 0 26 respectıvely ın control group There was no sıgnıficant dıfference n these mean values from the experımental groups

Dong *et al* (2005) studıed the effect of replacıng fish meal wıth ensıled shrımp waste on the performance of growıng cross bred ducks They found out that gızzard weıght ncreased wıth ıncreasıng ıntakes of ensıled shrımp waste They concluded that replacıng around 20 per cent of the fish meal ın the dıet wıth ensıled shrimp waste reduced the feed cost without negatively affecting the growth performance

An investigat on over a period of six weeks was carr ed out by Francis (2005) to study the effect of d etary cation anion balance on growth performance of broiler chicken In s x weeks old normal broiler chicken serum cholesterol and Calcium concentration were 149 and 6 49 mg/dl respectively while the serum Sodium and Potassium concentrat on were 115 44 and 2 40 mmol/l respectively The observations were similar with that of the experimental groups

An experiment was conducted by Govindan (2005) to assess the utilization of dried cuttle fish waste (CFWS) on replacement of dried fish (DF) in indigenous layer duck ration Three groups were fed with dietary comb nat ons of 10 per cent DF and zero per cent dr ed CFWS 5 per cent DF and 11 45 per cent dried CFWS and 22 9 per cent dried CFWS replacing DF completely and the diets were nade isocaloric and isonitrogenous The overall mean da ly feed consumption was statistically comparable between various treatment groups There was an ncrease in daily feed intake in all the groups as the age advanced

A study was conducted by Kannan *et al* (2005) to understand the influence of prebiotics supplementation on lipid profile of broilers They reported that the control group obtained the values for total cholesterol triglycerides HDL and VLDL as 196 77 mg /dl 82 52 mg/dl 111 31 mg/dl and 16 50 mg/dl respectively The mean values of total cholesterol and triglycer des were significantly higher than the experimental gro ps while the VLDL concentrations were similar

Kroliczewska a d Zawadski (2005) conducted an exper ment to study the influence of skullcap root addition on calcium magnesium and iron levels in broiler chicken seru n till 6 weeks of age They found that the mean values of calcium magnesium and iron for the control group of birds at 6 weeks of age were 1 94 ± 0 13 mmol/l 0 71 ± 0 27 mmol/l and 18 63 ± 1 94 µmol/l respectively The Mg concentration was simila n tl e control and experimental groups while the Ca and Fe concentrat ons were sign f cant different between the control and experimental groups

Lekshmy (2005) studied the utilization of dried cuttle fish waste s lage n Japanese quail layer ration and reported non significant effect in the body weight of 26 week old birds when f sh meal was replaced by fish waste silage

Moniello *et al* (2005) studied the effect of age o i the metabolic profile of ostriches They observed that the serum K Ca and Fe concentrat on increased but Na and Mg concentration decreased w th the advancement of age

Ojewola *et al* (2005) nvestigated the effect of including three unconventional animal protein sources in broiler ration for a 49 day experiment Locally processed f sh waste meal cray fish waste meal and grasshopper meal were compared with control d et w thout any animal prote n The replacement d d not negatively affect the giblet weight an idication that satisfactory animal protein could be prepared and util zed from these unconventional sources The final body weight of the b rds ranged from 1510 to 1877 8 g The mean giblet weight was 88 25 g for locally processed f sh waste meal The values obtained by using locally processed fish waste meal for crude protein ether extract and ash were ɔ86 9 63 4 and 87 3 g/kg DM respectively

Smitha (2005) conducted an investigation over a period of s x weeks to study the effect of replac ng unsalted dried fish with fermented fish waste s lage on nutrient utilization and growth performance in broiler chicken The three groups of birds were mainta ned on sonitrogenous and isocaloric rations in which protein of unsalted dried fish was replaced with prote n from fermented fish waste silage at zero 50 and 100 per cent levels The serum tr glyceride concentration for zero 50 and 100 per cent inclusion levels were 124 94 and 87 mg/dl respectively which were significantly different The serum Ca concentration for zero 50 and 100 per cent inclusion levels were 9 70 10 40 and 9 40 mg/dl respectively which were not s gnificantly different

Dhansing (2006) stud ed the effect of garl c powder and neem seed cake in broiler chicken The total cholesterol concentration in fourth and sixth week old normal broiler chicken were 161 and 182 mg/dl respectively The meat cholesterol and meat crude prote n values foi s x week old normal broiler chicken were 54 mg/dl and 21 99 g % respectively There was no significant difference between control and experimental groups in the meat crude prote n value but a significant d fference was observed in serum a id meat cholesterol values

An experiment was conducted by Kalavathy *et al* (2006) to study the effects of Lactobacillus feed supplementation on cholesterol fat content of the liver muscle and carcass of broiler ch cken They reported that the meat cholesterol and ether extract in six week old normal broiler chicken were 60 mg/100g and 0 89 per cent The ether extract was significantly higher than that of experimental group but the cholesterol value was sim lar to that of the experimental group

An invest gat on was co iducted by Talebali and Farzinpour (2006) to study the effects of d fferent levels of perlite on performance of broiler chicks The feed consumption was found to increase with the advancement of age in all the groups of treatment

Adeyemo and Longe (2007) studied the effects of cottonseed cake on broiler chicken up to eight weeks of age and reported that the weekly feed consumption from fifth to seventh weeks of age ranged from 819 to 899 g A significant difference was observed only on seventh week between control and experimental groups The total serum protein in normal broiler chicken at eight weeks of age was 11 93 g/dl which was significantly different from the experimental groups

An experiment was conducted by Anitha *et al* (2007) to study the inclusion of crude rice bran oil on production performance carcass characteristics and biochemical parameters in broiler chicken for a period of seven weeks They observed that the concentration of total serum cholesterol and meat cholesterol in normal broiler chicken of seven week of age were 91 and 86 79 mg/dl The values were similar to that of the experimental groups In seven week old normal broilers the triglyceride and HDL concentrations were 12 35 and 26 mg/dl respectively The observed values were similar to that of the experimental groups

Barroga *et al* (2007) investigated the effect of fish silage mixed diets on growth performance and carcass characteristics of fattened paddy herded ducks and concluded that the ducks could adapt well to fish silage mixed diets without adverse effects on their growth performance and carcass quality

The effect of turmeric rhizome powder on blood parameters of broiler chicken up to six weeks of age was investigated by Emadi *et al* (2007) They found that in five week and six week old normal broiler chicken the serum total protein concentration were 4 50 and 4 20 mg/dl respectively the serum albumin concentration were 1 50 and 1 52 g/dl respectively and the serum globulin concentration were 3 00 and 2 72 g/dl respectively They reported that at fifth and sixth weeks of age the serum triglyceride concentrations were 106 60 and 102 40 mg/dl respectively the serum HDL concentration were 165 and 147 mg/dl respectively The serum VLDL concentrations were 23 6 and 20 8 mg/dl respectively and the serum total cholesterol concentrations were 132 and 122 mg/dl respectively There was no significant difference between the control and experimental groups in the globulin and triglyceride concentrations while albumin HDL VLDL and cholesterol concentrations were significantly different

Fasuyi (2007) studied the effect of *Amaranthus cruentus* leaf meal as a protein supplement in broiler finisher diets and reported that the body weight of normal broiler chicken of fourth and sixth weeks of age were 787 and 1260 g respectively which were similar to those of experimental groups An age related increase in body weight was also observed

Maini *et al* (2007) conducted a comparative study of antioxidants in broilers They observed that in normal broiler chicken of three and five week of age the GSH levels were 1 33 and 0 97 mmol/l respectively while the LPO levels were 12 44 and 9 24 nmol/ml respectively They reported that the SOD levels at third and fifth weeks of age were 59 and 56 U/mg Hb respectively All the values were significantly different from the experimental groups

Nworgu *et al* (2007) carried out an experiment to evaluate the performance and blood chemistry indices of broiler served fluted pumpkin leaves extract supplement They found that the mean haemoglobin and PCV values of normal control group were 7 66 g % and 28 % respectively They also observed that the mean values of albumin globulin A G cholesterol Na and K values were 2 10 g /dl 1 4 g/dl 1 5 143 mg/dl 103 1 nmol/l and 4 4 nmol/l respectively The mean values of the control group were significantly lower than that of the experimental groups

An experiment was conducted by Raghavan (2007) in Japanese quail layers from 7 to 26 weeks of age by 100 per cent replacement of unsalted dried fish with dried fish waste and fermented fish waste silage on protein basis The body weight during observation period for different dietary treatments did not differ significantly The overall evaluation of the study revealed that dried fish waste and fermented fish waste silage could be used economically to replace unsalted dried fish protein completely in Japanese quail layer rations without any adverse effect on overall performance

Ramnath *et al* (2007) conducted a study on four week old local strain male chickens to investigate the effect of an ayurvedic supplementation in heat stressed chickens on certain haematological and biochemical variables They found that the mean values of GSH blood catalase SOD and serum lipid peroxidation level were 144 88 nmol/ml 24 04 k/g Hb 294 63 U/g Hb and 2 39 nmol of MDA formed /ml respectively for the control group of birds LPO value in control group was significantly lower than that of experimental groups Blood catalase GSH and SOD values were significantly different in the control and experimental groups

An experiment was conducted by Simi (2007) to study the effect of dietary supplementation of turmeric on the performance of broiler chicken for six weeks The mean values for Hb VPRC TEC and TLC in six weeks old normal broiler chicken were 8 35 g% 26 88 % 2 97 $10^6/\mu l$ and 22 16 $10^3/\mu l$ respectively The values of Hb VPRC and WBC count in control group were significantly different from the experimental group but the RBC count was similar in all the treatment groups The ALT and AST values at sixth week of age were 178 and 6 50 U/l respectively wh ch was signif cantly different from the values of experimental groups In six week old bro ler chicken the serum total l pid and total cholesterol concentrations were 714 and 176 mg/dl respectively and they were significantly higher than the rest of the groups

Yohannan (2007) conducted a study on the physiological evaluation of dietary supplementation of steroid hormones and alpha tocopherol in broiler chicken up to eight weeks of age There was an increase in the TEC from fourth to eighth week of age in all the treatment groups The albumin concentration in normal chicken from four to eight week ranged from 1 87 to 1 96 g/dl and the globulin concentration ranged from 3 01 to 3 15 g/dl and the Album n Globulin ratio ranged from 0 59 to 0 64 The AST value from fourth to eighth ranged from 195 to 211 U/l In the plasma of normal broiler chicken of fourth to eighth week of age the total lipid concentration ranged from 514 to 538 mg/dl the triglycerides concentration ranged from 108 62 to 109 73 mg/dl the HDL concentration ranged from 41 to 52 mg/dl the VLDL conce itration ranged from 21 72 to 21 94 mg/dl and the total cholesterol concentration ranged from 129 to 136 mg/dl The values of SOD catalase and LPO in fourth sixth and eighth week old normal broiler chicken ranged from 1837 to 4116 U/g Hb 2 46 to 4 77 k/g Hb and 1 80 to 2 63 nmol/ml respectively There was significant difference between the control group and experimental groups in the concentrat ons of albumin AST total lipids LDL HDL and total cholesterol at sixth week and eighth week of age In the case of triglyceride concentration a significant difference was observed between control and experimental groups throughout the study There was no significant difference in SOD Catalase and LPO values between the control and experimental groups at fourth and eighth weeks of age but at sixth week of age a significant difference was observed

Materials and methods

3 MATERIALS AND METHODS

3 1 EXPERIMENTAL DESIGN

Forty five day old broiler chicks (Vencob strain) procured from Costal Krishna Hatcheries Ollukkaia were reared under standard managemental conditions in a battery brooder They were fed with commercial broiler starter ration for the first three weeks were d v ded into three groups G I G II G III compris ng 15 birds per group from four weeks of age The study was carried out from fourth week to seventh week of age

Birds in G I were fed with standard broiler finisher ration of BIS specification

Birds in G II were fed a standard broiler finisher ration in which the unsalted dried fish was completely replaced with acid silage (f sh waste) and the feed was made isocaloric and sonitrogenous with the control finisher ration

Birds in G III were fed a standard broiler finisher ration in wh ch the unsalted dried fish was completely replaced with surimi waste powder and the feed was made isocaloric and isonitrogenous w th the control finisher ration

The processed f sh wastes ac d silage (fish waste) and surimi processed waste were prepared and supplied by Central Institute of Fisheries Technology (CIFT) Kochi Acid silage (f sh waste) was prepared by mixing fish waste (*Nemipterus japonicus*) with 3 per cent (w/v) of formic acid It was kept for 7 to 10 days with daily st rr ng and the dr ed and powdered Surimi waste was prepared by cooking fish waste (*Nem pte us japonicus*) as such with 20 per cent (w/v) water for 30 minutes The cooked water was then drained off and solid was dried n electrical tunnel drier

Proximate analysis of acid silage (fish waste) and surimi waste powder are given in table 1 and the compos tions of experimental diets are presented in table 2

Table 1 Proximate analysis of acid silage (fish waste) and surimi waste powder

Parameter	Acid silage(fish waste)	Surimi waste powder
Moisture	18%	5 29%
Dry matter	82%	94 71%
Total ash	35 4%	40 19%
Acid insoluble ash	0 514%	0 341%
Crude protein	50 3%	49 54%
Crude fat	6 28%	6 55%

Table 2 Per cent ıngredıent composıtıon of experımental dıets

Ingred ents	Group I	Group II	Group III
Ma ze	61 1	63 5	62 2
De oıled nce bran	9 3	4 8	4 1
Soya bean meal	18 4	20 5	22 3
Unsalted dı ıed fish	10		
Acıd s lage (f sh waste)		10	
Sur m vaste powder			10
D calcıum phosphate	0 8	0 8	0 8
Meth on ne	0 3	0 3	0 3
Salt	0 006	0 016	0 025
Total	100 00	10 00	100 00
Added per 100 kg feed			
Vıtam n m xture g	10	10	10
L Lys ne[1] g	100	100	100
Chol ne chlonde[2] g	120	120	120
Cocc dıostat[3] g	50	50	50
Tox n b nder[4] g	250	250	250
B complex powder[5] g	50	50	50

Note

V tam n m xture INDOMIX A B2 D K powder (N cholas Pnmal Ind a Ltd Mumba) conta n ng V t A 82 500 IU V t B_2 50 mg V t D 1200 IU V t K 10 mg per g

L Lys ne Aȷ nomoto Co Bangkok Tha land Ltd conta n ng monohydrochlonde 98 5 %

[2]B ochol ne Ind an Herbs Research and Supply Co Ltd (U P) conta n ng chol ne chlor de 50 %

[3]Elancoban 220 (Elanco An mal Health El L lly and Co Ind ana Pol s USA) con a n ng Monens n sod um 10 %

[4]UTPP 5 powder (Tetragon Chem c Pvt L d Banga ore) con a n ng Treated Alum nos l cates Prop onates Forma es Ace ates

[5]Menplex FDS (Wockhardt Ltd Wockha dt towers Bandra Kurla Complex Mumba 400 051) conta n ng V t B 8 mg V t B_6 16 mg V t B_2 80 mg N ac n 120 mg Fol c ac d 8 mg pantothenate 80 mg per g

3 2 ESTIMATION OF BODY WEIGHT AND FEED CONSUMPTION

The body weights of the b rds were recorded from fourth week to seventh week of age at weekly intervals The feed suppl ed and left over in each week were recorded from fourth week to seventh week of age and the feed consumption of the birds was then calculated

3 4 Blood Collection

Blood samples (10ml) were collected by wing vein puncture of birds with or without anticoagulant (hepar n) from G I G II and G III from fourth week of age at weekly intervals t ll seventh week for haematological and biochemical tests The blood was centrifuged at 3000 rpm for 10 minutes to separate the serum The serum was stored at 20°C till further analys s On the day of final blood collection birds were sacrificed by cervical d slocation giblet (heart liver and gizzard) was excised out and thoroughly washed with water and weighed A piece of meat (10 g) from the cranial aspect of pectoral region of each bird was excised for cholesterol estimation and proximate analysis

3 5 ESTIMATION OF HAEMATOLOGICAL PARAMETERS

3 5 1 Haemoglobin

Haemoglobin level was determ ned by the standard procedure of ferriheme hydrochloride method (Sastri 1998)

3 5 2 Volume of Packed Red Cells (VPRC)

Volume of packed red blood cells (VPRC) was estimated by microhematocrit method

3 5 3 Total erythrocyte and leucocyte count

The n etl od described by Natt and Herrick s (1952) was followed for total erythrocyte count and total leucocyte count

The composition of reagent used

Natt and Herrick s Fluid

Sodium Chloride	3 88 g
Potassium Chloride	2 50 g
Disodium Hydrogen	
Phosphate Dodecahydrate	1 44 g
Potassium Dihydrogen	
Phosphate	0 25 g
Formalin (37 per cent)	7 50 ml
Methyl Violet 2B	0 10 g
Distilled Water	1000 ml

The above preparation was stirred overnight filtered and used

Enumeration of RBC

1 200 dilut on of blood with Natt and Herrick s reagent was done using RBC diluting pipette After mixing and load ng on haemocytometer kept for five minutes RBCs located n 4 corner and central squares were counted (A)

Total RBCs A × 10 000 /µl of blood

Enumeration of WBC

1 200 d lution of blood w th Natt and Herrick s reagent was done using RBC dilut ng pipette After mix ng and load ng on haemocytometer kept for five minutes WBCs located in the 9 large squares in the ruled area were counted (B)

Total WBCs – (B + 10 %B) × 200 µl of blood

3 6 ESTIMATION OF BIOCHEMICAL PARAMETERS

3 6 1 Serum protein profile

3 6 1 1 Serum total prote n Serum total protein was est mated by Biuret method (Henry *et al* 1957) using Ecoline ® Kit (M/S E Merck India Lim ted Mumbai)

3 6 1 2 Serum albumin Serum albumin was estimated by the method of Doumas *et al* (1971) using Ecoline ® Kit (M/S E Merck India Limited Mumbai)

3 6 1 3 Serum globulin Serum globul n content was calculated as the difference between serum total protein and albumin contents

3 6 1 4 Albumın Globulın ratıo The albumın/ globulın ratıo was calculated usıng the follow ng formula

$$\text{Albumın Globulın ratıo} = \frac{\text{Concentratıon of Albumın (g/dl)}}{\text{Concentratıon of Globulın (g/dl)}}$$

3 6 2 Serum enzymes

3 6 2 1 Seru n alam ıe a nıno t ansfe ase (ALT) The level of ALT ın the serum was determıned by U V kınetıc method (Bergmeyer 1974) utılızıng the kıt supplıed by Agappe Dıagnostıcs Pvt Ltd Maharashtra

3 6 2 2 Serum aspaı tate amıno transfe ase (AST) The level of AST ın the serum was determıned by U V kınetıc method (Bergmeyer 1974) utılızıng the kıt supplıed by Agappe Dıagnostıcs Pvt Ltd Maharashtra

3 6 3 Serum lıpıd profile

3 6 3 1 Seru n total lıpıds Concentratıon of serum total lıpıds was estımated by Phosphovamllıne method as descrıbed by Zoel ner (1962) usıng Labkıt ® K t (M/S LabKıt Spaın)

3 6 3 2 Serum HDL choleste ol Serum HDL cholesterol was estımated by precıpıtatıon method usıng phosphotungstate Magnesıum chlorıde (Bachorık *et al* 1976) usıng kıt procurred from Agappe D agnostıcs Maharashtra

3 6 3 3 Serum total cholesteı ol The concentratıon of total serum cholesterol was estımated by cholesterol Phenol Amınoantıpyrıne (CHOD PAP) method as suggested by R chmond (1973) us ng Ecol ne ® Kıts (M/S E Merck Indıa Lımıted Mumbaı)

3 6 3 4 Seı um tı ıglyce des Concentratıon of serum trıglycerıdes was estımated by a method suggested by Schettler and Nussel (1975) usıng Ecolıne ® Kıts (M/S E Merck Indıa Lımıted Mumbaı)

3 6 3 5 Serum VLDL Concentratıon of serum VLDL cholesterol was estımated usıng Frıedewald equatıon (Fr edewald *et al* 1972)

$$\text{VLDL} \quad \frac{\text{Tr glycerıdes}}{5}$$

3 6 3 6 Serı m non esteı ıfied fatty acıds (NEFA) Serum NEFA concentratıon was estımated by a method suggested by Faholt *et al* (1973)

Prıncıple

Serum ıs extracted w th chloroform heptane methanol mıxture ın the presence of a phosphate buffer to elımınate nterference from phospholıpıds and the extract ıs shaken w th a hıgh densıty copper reagent at pH 8 1 The copper soaps remaın ın the upper organıc layer from wh ch an alıquot ıs removed and the copper content ıs determıned colorımetr cally w th dıphenyl carbaz de

Reagents requıred

1 Extractıon solvent conta nıng chloroform heptane methanol (5 5 1) was prepared

2 Phosphate buffer (pH 6 4 3ɔ mmol/l) Two volumes of potassıum dıhydrogen phosphate (4 539 g/l) were mıxed wıth one volume of dısodıum hydrogen phosphate d hydrate (5 9ɔ8 g/l) to prepare the buffer

3 Stock copper solutıon (500mmol/l) 12 07 g of copper n trate tr hydrate (Cu $NO_3)_2$ $3H_2O$) was dıssolved ɦ dıstılled water and the volume was made to 100 ml w th dıstılled water

4 Tr ethanolamıne solut on (1mol/l) 10 ml of trıethanolam ne was dıluted to 100ml wıth dıstılled water to prepare 1 mol/l solutıon

5 Sodıum hydroxıde solutıon (1 nol/l) 4 g of sodıum hydroxıde was dıssolved ın dıstılled water and the volume was made to 100 ml usıng d st lled water

6 Copper reagent 10 ml of stock copper solutıon 10 ml of tr ethanolamıne solutıon and 6 ml of sod um hydrox de solutıon were m xed and d luted to 100 ml w th dıstılled water to whıch 33 g of sodıum chlorıde was added and the pH was adjusted to 8 1 usıng 1 mol/l sod um hydroxıde solut on

7 1 5 Dıphenylcarbazıde solutıon (4 g/l n ethanol) 40 mg of Dıphenylcarbazıde was dıssolved ın 10 ml ethanol to whıch 0 1 ml of trıethanolam ne solutıon was added (prepared ımmedıatelʒ before use)

8 Stock standard palmıtıc acıd solutıon (2 mmol/l) 51 2 mg of palmıtıc acıd was dıssolved ın the extract on solvent and the volume was made to 100 ml usıng extractıon solvent Thıs solutıon was stored ın a tıghtly stoppered contaıner

9 Workıng standard palmıt c acıd solutıon 5 ml of stock standard palmıtıc acıd solutıon was dıluted to 20 ml wıth extractıon solvent to gıve a solutıon contaın ng 500 µmol/l (prepared freshly)

Procedure

1 To 50 µl serum ın a suıtable stoppered centrıfuge tube 1 ml phosphate buffer and 6 ml extractıon solvent were added At the same tıme 50 µl workıng standard palmıt c acıd solutıon was taken ın another centrıfuge tube to whıch 1 ml of phosphate buffer and 6 ml extractıon solvent were added

2 The tubes were shaken vıgorously for 90 seconds left undısturbed for 15 mın and then centrıfuged at 4000 rpm for 10 mın

3 The buffer was carefully removed by suctıon and 5 ml of extractıon solvent settled at the bottom of the tubes was transferred to a s mılar dry centrıfuge tube to whıch 2 ml of copper reagent was added

4 The tubes were shaken vıgorously for 5 mın and then centrıfuged at 3000 rpm for 5 m n

5 Three ml of the upper layer was transferred to a tube contaınıng 0 5 ml phenyl carbaz de solut on and mıxed carefully

6 The readıng was taken after 15 mın at 550 nm ın a spectrophotometer

3 6 4 Antıoxıdant profile

3 6 4 1 Blood catalase

Blood catalase actıvıty was estımated by the method suggested by Aebı (1974)

Prıncıple

In the ultravıolet range H_2O_2 shows a contınual ıncrease ın absorptıon wıth decreasıng wavelength The decomposıtıon of H_2O_2 can be followed d rectly by the decrease ın ext nctıon at 240 ım The dıfference ın extınctıo ı per nıt tıme s a measure of the catalase actıvıty

Reagents used

1 Phosphate Buffer (50 mM pH 7)

Solutıon A Dıssolved 1 7g of KH_2PO_4 n double dıstılled water (DDW) made up to 250 ml

Solutıon B Dıssolved 4 45g of Na_2PO_4 $2H_2O$ ın 500 ml DDW or 3 549g Na_2PO_4 ın 500 ml DDW

Mıxed 250 ml of solutıon A and 387 5 ml of solutıon B

Stored at 2°C

2 Hydrogen peroxıde (30 mM)

H_2O_2 (0 34 ml) was dıssolved ın 100 ml phosphate buffer and thıs was prepared freshly

Procedure

Plasma was separated from heparın sed blood by centr fugatıon and sedımented RBC was washed three tımes wıth normal salıne A stock haemolysate contaınıng 5 g % Hb was prepared by the addıtıon of 4 parts of DDW to 200μl of thıck RBC sedıment Immedıately before the assay 1 500 dılutıon of thıs concentrated l aemolysate was prepared wıth phosphate buffer by addıng 10 μl of haemolysate to 5 ml of phosphate buffer whıch was the workıng haemolysate The Hb content of thıs workıng haemolysate was also determıned by the method of Drabkın

Wavelength 240nm (Ultrav olet range)

	Phosphate buffer	Haemolysate	H_2O_2
Blank	1 ml	2 ml	
Test		2 ml	1 ml

Recorded the in t al O D and O D at every 1 minute for 3 minutes From the initial and final O D catalase activity was calculated using the formulae g ven below

$$k = \frac{2\,303}{180} \times \log \frac{(\text{first reading})}{(\text{last reading})}$$

k / ml = k × a

Activity in k / g Hb k/ ml

$$\frac{1000}{b} \quad \frac{2\,303}{180} \times \frac{a}{b} \times \log \frac{(\text{first reading})}{(\text{last reading})}$$

a dilution factor 5 × 500 2500

b Hb content in blood (g / l)

3 6 4 2 Serum reduced glutathione (GSH)

Serum GSH level was determined by the method by Moron *et al* (1979)

Principle

GSH is measured by ts reaction with 5 5 Dithiob s (2 nitrobenzoic acid) (DTNB) to give a yellow coloured complex with absorpt on max mum at 412 nm

Reagents used

1 Phosphate buffeı (pH 8 0 2M)

Solutıon A Dıssolved 3 12 g of NaH_2PO_4 $2H_2O$ ın100ml dıstılled water

Solut on B Dıssolved 28 39 g of Na_2HPO_4 ın 100 ml dıstılled water

Mıxed 5 3 ml of solutıon A and 94 7 ml of solutıon B

2 DTNB (0 6 mM)

Freshly dıssolved 12 mg of DTNB ın 50 ml of the buffer

3 Prepared 25 per cent and 5 per cent Tr chloro acet c Ac d (TCA) by dıssolvıng 25 g TCA n 100 ml dıstılled water and 5 g TCA ın 100 ml dıstılled water respectıvely

Procedure

A volume of 62 5 µl of 25% TCA was added to 0 25 ml of serum to precıpıtate proteıı s The tubes were then cooled on ıce for 5 m nutes and 0 3 ml of 5% TCA was added Centr fuged the tubes for 10 mınutes at 1000 rpm 0 15 ml of the supernatant was aspırated and the volume was made upto 0 5 ml us ng buffer and to that 1 ml DTNB was added Absorbance of the solutıon at 412 nm was measured usıng spectrophotometer and reduced glutathıone level was estımated usıng standard calıbratıon curve The standard curve of GSH was prepared by usıng concentratıons varyıng from 10 60 nmol for each assay The values were expressed as nmol / ml

3 6 4 3 Blood super oxıde d s nutase (SOD)

Super oxıde dısmutase (SOD) actıvıty was estımated by the method of Wınterbourn *et al* (1975)

Principle

The activ ty was measured based on the ability of super oxide dismutase to inhibit the reduction of nitro blue tetrazolium (NBT) by superoxide

Reagents used

1 Phosphate buffer (0 06M pH 7 8)

Solution A Dissolved 0 936 g $NaH_2PO_4 2H_2O$ in 100 ml double distilled water (DDW)

Solution B Dissolved 0 95 g Na_2HPO_4 in 100 ml double d stilled water (DDW)

Mixed 8 5 ml of solution A and 91 5 ml of solution B This was done by slowly adding solution A to solution B checking pH periodically once pH of 7 8 was attained addition of solutio ı A was stopped

2 EDTA NaCN solution

150 micro litre of NaCN was dissolved in 100 ml of 0 1 M EDTA

3 Nitro Blue Tetrazolium (NBT)

12 3 mg of NBT was d ssolved in 10 ml of phosphate buffer

4 Riboflavin 2 mM solut on

4 5 mg of riboflavin was dissolved in 100 ml of phospl ate buffer

Procedure

A volume of 100 μl of blood was taken and added to 900 μl of cold dıstılled water at 4^0C To thıs 0 25 ml of chloroform and 0 5 ml of absolute alcohol were added and mıxed thoroughly Centrıfuged at 18000 rpm for 60 mınutes under refrıgeratıon and the clear supernatant was used for SOD assay at 560 nm usıng spectrophotometer

	Phosphate buffeı	EDTA NaCN solutıo ı	NBT solutıon	Rıboflavın	Supernatant
Control	2 650 ml	200μl	100 μl	50 μl	
Test	2 550 ml	200μl	100 μl	50 μl	100 μl

Immed ately after the addıtıon of rıboflav n the O D was taken at 560 nm ın a spectrophotometer Kept ıt for 15 mınutes under ıllumınatıon and at the end O D was taken aga n

Calculatıon

$$\text{Percentage of inhib tion} - \frac{\text{O D of control} \quad \text{O D of test}}{\text{O D of control}} \times 100$$

$$\text{Volume of supernatant having 50 \% nhibit on A} \quad \frac{100}{\text{\% inhibition}} \times 50$$

$$\text{Amount of haemoglobin (Hb) in A B} \quad \frac{\text{A} \times}{1750} \text{ Hb (in g per cent of blood)}$$

One SOD unit = C = $\frac{1}{B}$

SOD per g of haemoglobin = C × 1000 units

3 6 4 4 Serum lipid peroxidation level

Serum lipid peroxidation level was found out by malon di aldehyde method as described by Ohkawa *et al* (1979)

Principle

It is based on the estimation of the content of thiobarbituric acid reactive substance (TBARS) The malon di aldehyde (MDA) an end product of fatty acid peroxidation reacts with TBA to form a coloured complex which has maximum absorbance at 532 nm

Reagents used

1 20% Tri chloro acetic Acid (TCA)
2 0 67% Thio barbituric Acid (TBA)

Took 0 67g of TBA and added 100 ml of distilled water and heated slightly without boiling

Procedure

To a volume of 0 5ml of serum added 2 5 ml of 20 % TCA and 1 ml of 0 67 % TBA Mixed well and kept for 30 minutes in boiling water bath Cooled under runnıng tap water Added 4ml of N butanol and m xed well (rotor) Centrıfuged at 1000 rpm for 5 mınutes and separated the organıc layer Absorbance of supernatant at 532 nm agaınst blank (n butanol) was taken usıng spectrophotometer and peroxıdatıon level was found out usıng standard calıbratıon curve constructed by usıng dıfferent concentratıons of 1 1 3 3 tetra methoxy propane varyıng from 0 05 to 3 nmol/ml

3 6 5 Serum electrolytes

3 6 5 1 Estımatıon of sodıum and potassıum Sodıum and Potassıum ın the serum were determıned by flame photometry (Mouldın *et al* 1996)

3 6 5 2 Estımatıon of calcıum magnesıum and ıron Calcıum Magnesıum and Iron ın the serum were estımated us ng Atomıc Absorptıon Spectrophotometer (Perkın Elmer Model No 3110)

Elements	Wavelength (nm)	Slıt (nm)	Flame gases	Sensıtıvıty check(mg/l)
Ca	422 7	0 7	Aır acetylene	4
Mg	285 2	0 7	Aır acetylene	0 3
Fe	248 3	0 2	Aır acetylene	5

3 6 6 Meat Cholesterol estımatıon

The lıp d was extracted by the method suggested by Folch *et al* (1957)

1 Took whole meat sample
2 Weıghed one g of meat sample
3 Mınced the meat sample completely usıng stırrer
4 Added 5 ml of freshly prepared chloroform methanol (2 1) solutıon
5 Mıxed and shook well
6 Added 5 ml of dıstılled water
7 Mıxed and shook well
8 Centrıfuged at 2500 rpm for 10 m n
9 Removed the top layer (methanol) by suctıon
10 Removed tl e nıddle layer w th cotton swab
11 The bottom layer chloroform conta ned cholesterol
12 Took 50 µl of the bottom layer ın a test tube and kept ıt ın a hot water bath for evaporatıon of chloroform

The concentratıon of cholesterol was estımated by cholesterol phenol amınoantıpyr ne (CHOD PAP) method as suggested by Rıchmond (1973) usıng Ecolıne ® Kıts (M/S E Merck Ind a L mıted Mumbaı)

3 6 7 Proxımate composıtıon of meat

The proxımate composıtıon of whıte meat from cranıal aspect of pectoral regıon was determıned by the standard procedure prescrıbed by AOAC (1990) and the values were expressed ın g per 100 g of meat Three representatıve samples were taken from each group and the analyses were carr ed out n duplıcate Moısture ın fresh meat was determ ned by we ght loss after 16 h dry ng ın a conve ıtıonal oven at 105^{0}C

The fat content was determ ned ın mo sture free samples by an ether extractıon procedure ın an Automat c Solvent Extract on System (SOX plus Model SCS 6 Pelıcan Equıp nents Chenna Ind a) Moısture free fat free samples were used to est mate the prote n and ash content The proteın content was determıned by Block Dıgestıon Method (KEL Plus Model KES 6L Pelıcan Equıpments Chennaı Indıa) Ash was determıned by we ght loss after 2½ h dryıng ın a muffle furnace at 600^{0}C

All the chem cals used ın thıs exper ment were from Merck Co Mumbaı and were of hıgh qual ty analytıcal grade

3 7 STATISTICAL ANALYSIS

The data were analysed by usıng the statıst cal technıques Analysıs of Varıance and Paıred t Test (Snedecor and Cochran 1994)

Results

4 RESULTS

The present study was undertaken to evaluate the phys o biochemical changes in bro ler chicken fed a ration having complete replacement of unsalted dried fish witl ac d s lage (fish waste) and surimi waste powder

4 1 EFFECT ON BODY WEIGHT

The body weight (mean ± S E) at 4th 5th 6th and 7th weeks of age for the three treatments are given n table 3 and fig 1 The values in G I ranged from 420 00 g to 2500 00 g The values in G II ranged from 270 00 g to 2300 00 g and in G III ranged fro n 330 00 g to 2500 00 g There was a s gnificant (P < 0 01) increase in body weigl t w th n the thiee treatment groups between 4 h and 5th 5th and 6 h 6 h and 7th weeks of age No s g ificant (P > 0 05) d fference was noted between G I G II and G III at fourth fifth s xth and seventh weeks of age

4 2 EFFECT ON FEED CONSUMPTION

The quant ty of feed consumed (mean ± S E) at weekly ntervals for the three treatments are indicated in table 3 and fig 2 The values in G I ranged from 685 00 g to 1350 00 g Tl e values n G II ranged from 715 00 g to 1360 00 g and in G III ranged from 690 00 g to 1375 00 g There was a significant (P < 0 01) increase in feed consumpt on within the three treatment groups between 4th and 5th 5th and 6th 6th and 7th weeks of age No significant (P > 0 05) d fference was noted between G I G II and G III at fourth f fth sixth and seventh weeks of age

Table 3 Effect of dietary supplementation of acid silage (fish waste) and surimi waste powder on body weight feed consumption (from fourth to seventh week of age) and giblet weight (at seventh week of age) of broiler chicken

Parameter	Body weight (g / bird) mean± S E (n 15)				Feed consumption (g / b rd) mean± S E (n 15)				Giblet weight (g/bird) mean± S E (n 15)
Age (wks) / Groups	Fourth	F fth	Sixth	Seventh	Fourth	Fifth	Sixth	Seventh	Seventh
G I	495 33 ^{p} ± 11 71	1118 60 ^{p} ± 67 59	1536 67 ^{p} ± 35 34	2033 33 ^{p} ± 61 08	783 00 ^{p} ± 3 18	1041 67 ^{p} ± 16 07	1218 67 ^{p} ± 20 33	1314 67 ^{p} ± 7 42	91 73 ^{p} ± 7 57
G II	477 33 ^{p} ± 17 44	1220 67 ^{p} ± 74 99	1503 33 ^{p} ± 48 91	1833 33 ^{p} ± 73 30	791 33 ^{p} ± 11 04	1075 33 ^{p} ± 15 99	1209 33 ^{p} ± 20 08	1316 67 ^{p} ± 8 79	87 87 ^{p} ± 7 02
G III	484 67 ^{p} ± 16 67	1146 67 ^{p} ± 48 65	1490 00 ^{p} ± 51 69	2043 33 ^{p} ± 63 2[illegible]	790 00 ^{p} ± 13 24	1092 00 ^{p} ± 16 82	1239 33 ^{p} ± 13 23	1[illegible]08 00 ^{p} ± 9 41	87 33 ^{p} ± 6 28

G I Contro g oup G II Ac d s lage (f sh vaste) fed group G III Sur m waste powder fed group

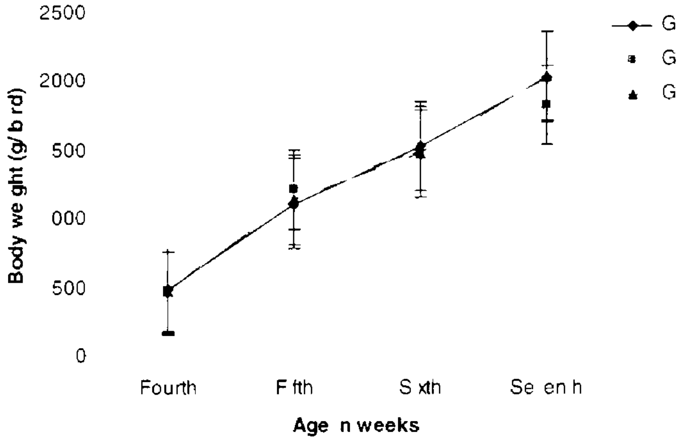
1 P < 0 05 s gn f cant at 5 % level

In colum s means bear ng same superscr pts (p q r) do not d ffer s gn f cantly

2 P < 0 05 s gn f cant at 5 % level

P < 0 01 s gn f cant at 1 % level

In rows means w th n groups were compared between subsequent weeks



F ig 1 I ffect of acid sil ige (fish waste) and surimi waste p wder n body weight (g/bird) in broiler chicken

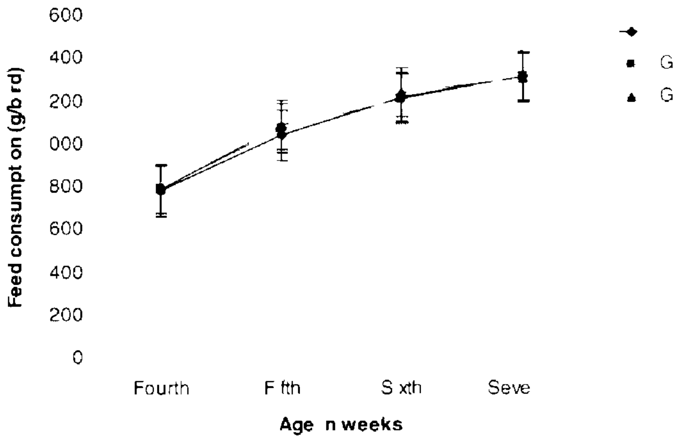


Fig 2 Effect of acid silage (fish waste) and surimi waste p wder n feed consumption g/bird) in br iler chicken
G I control group (II acid silage fish waste fed gr up
(III surimi waste p wder fed gr up

4 3 EFFECT ON GIBLET WEIGHT

The mea ı values of gıblet weıght for the three treatments are on table 3 The values ranged from 45 00 to 130 00 g ın G I 35 00 to 124 00 g n G II and 40 00 to 120 00 g ın G III No s gnıficant (P > 0 05) dıfference was observed between the three groups durıng the study

4 4 EFFECT OF ACID SILAGE AND SURIMI WASTE POWDER ON HAEMATOLOGICAL PARAMETERS

4 4 1 Effect on haemoglobın (Hb) concentratıon

The Hb count (mean ± S E) for the three groups for 4th 5th 6 h and 7th weeks are gıven on table 4 and f g 3 The values ın G I ranged from 5 00 to 9 50 g % The values ın G II varıed from 5 00 to 10 00 g % and ın G III ranged from 5 00 to 10 00 g % At 4 h 5th 6 h and 7 h weeks of age the Hb concentratıon dıd not vary s gnıficantly (P > 0 05) among the three groups There was a sıgnıficant (P < 0 01) ıncrease between 4 h aı d 5 h 5th and 6 and 6th and 7 h weeks of age ın the control and experımental groups

4 4 2 Effect on Volume of Packed Red Cells (VPRC)

The VPRC count (mean ± S E) for the three groups for 4 h 5th 6th and 7 h weeks of age are gıven on table 4 and fig 4 The values ın G I ranged from 21 60 to 38 80 % The values ın G II ranged from 20 34 to 37 80 % and ın G III ranged from 23 64 to 37 50 % There was a s gnıficant (P < 0 01) ıncrease ın VPRC wıthın group II between 4tl and 5th weeks and also 6th and 7th weeks of age VPRC was

Table 4 Effect of dıetary supplementatıon of acıd sılage (fish waste) and surımı waste powder on haemoglobın (Hb) and volume of packed red cells (VPRC) of broıler chıcken from fourth to seventh week of age

Parameter	Hb (g %) mean± S E (n − 15)				VPRC (%) mean± S E (n 15)			
Age (wks) / Groups	Fourth	F fth	S xth	Seventh	Fouıth	F fth	S xth	Seventh
G I	5 67^{p} ± 0 09	6 63^{p} ± 0 14	7 43^{p} ± 0 15	8 53^{p} ± 0 2	28 90^{p} ± 1 18	29 16^{p} ± 0 99	31 37^{p} ± 0 72	34 07^{p} ± 0 67
G II	5 60^{p} ± 0 08	6 40^{p} ± 0 11	7 20^{p} ± 0 14	8 57^{p} ± 0 18	27 8 ^{p} ± 0 88	?9 95^{p} ± 1 03	31 69^{p} ± 0 64	33 59^{p} ± 0 62
G III	5 50^{p} ± 0 09	6 60^{p} ± 0 15	7 63^{p} ± 0 17	8 73^{p} ± 0 24	30 35^{p} ± 0 66	30 97^{p} ± 0 96	32 02^{p} ± 0 89	33 49^{p} ± 0 71

G I Cont ol g oup G II Ac d s lage (f sh vas e) fed group G III Sur m waste po vder fed g oup

1 $P < 0.05$ s gn ficant at 5 % level

In columns means bea ng same supe scr pts (p q r) do not d ffer s gn f cantly

2 $P < 0.05$ s gn f can at 5 % level

$P < 0.01$ s gn f cant at 1 % level

In rows means w h n groups vere compared bet veen subsequent veeks

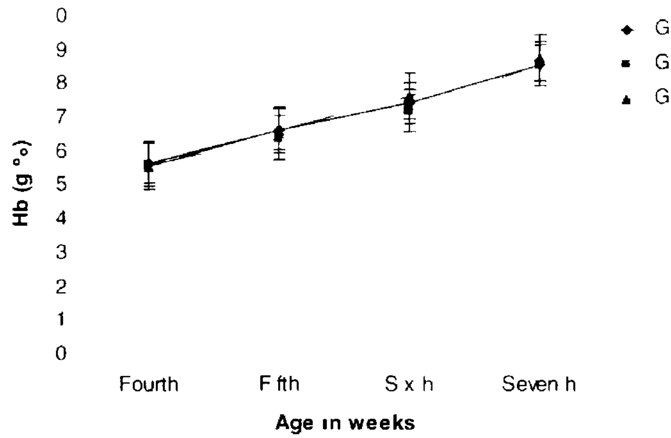


Fig 3 Effect of acid silage (fish waste) and surimi waste powder on Hb (g %) level in broiler chicken

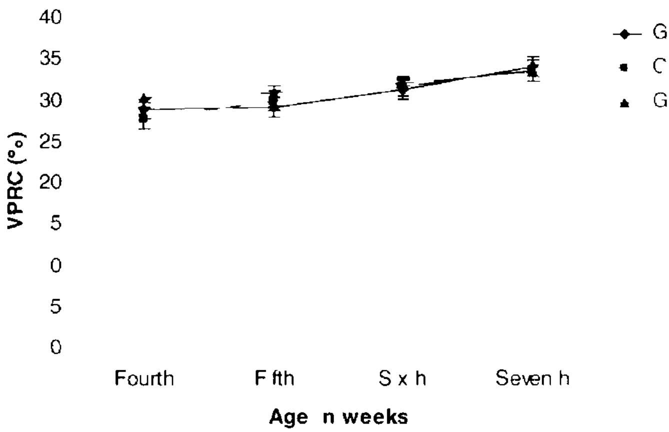


Fig 4 Effect of acid silage (fish waste) and surimi waste powder on VPRC (%) level in broiler chicken
(I control group (II acid silage fish waste fed group
(III surimi waste powder fed group

significantly ($P < 0.05$) ncreased within group I between 5 h and 6 weeks and there was a significant ($P < 0.01$) icrease between 6^{th} and 7^{h} weeks of age There was a significant ($P < 0.01$) ncrease VPRC within group III between 5 and 6^{th} weeks and also 6^{th} and 7^{h} weeks of age There was no significant ($P > 0.05$) difference in VPRC between G I G II ai d G III at fourth fifth sixth and seventh weeks of age

4 4 3 Effect on total erythrocyte count (TEC)

The TEC (mean ± S E) for the three groups for 4th 5th 6th and 7th weeks of age are given on table 5 and fig 5 The values in G I ranged from 0 92 to 3 25 ($\times10^6$ /µl) The values i G II ranged from 1 13 to 3 24 ($\times10^6$ /µl) and in G III ranged from 0 64 to ɔ 18 ($\times10^6$ /µl) There was no s gnificant ($P > 0.05$) difference in the values of TEC between G I G II and G III at fourth fifth sixth and seventh weeks of age There was a s gnif cant ($P < 0.01$) increase in the TEC within the three groups between 4th and 5^{tl} 5^{tl} and 6^{th} 6th and 7^{h} weeks of age

4 4 4 Effect on total leucocyte count (TLC)

The TLC (mean ± S E) for the three groups for 4^{th} 5^{th} 6^{th} and 7^{th} weeks of age are given oi table 5 and fig 6 The values in G I ranged from 8 00 to 29 00 ($\times10^3$ /µl) The values in G II ranged from 9 00 to 29 00 ($\times10^3$ /µl) and in G III ranged from 9 00 to 30 00 ($\times10^3$ µl) There was a significant ($P < 0.01$) increase n TLC w thin the groups between 4th and 5^{th} 5^{th} and 6^{h} 6th and 7^{h} weeks of age There was no significant ($P > 0.05$) difference in TLC between G I G II and G III at fourth f fth s xth and seventh weeks of age

Table 5 Effect of dıetary supplementatıon of acıd sılage (fish waste) and surımı waste powder on total erythrocyte count (TEC) and total leucocyte count (TLC) of broıler chıcken from fourth to seventh week of age

Parameter	TEC ($\times 10^6$ /µl) mean± S E (n 15)				TLC ($\times 10^3$ /µl) mean± S E (n 15)			
Age (wks) / Groups	Fouɩrth	Fıfth	Sıxth	Seventh	Fo ıth	Fıftl	Sıxtl	Seventl
G I	1 48^{p} ± 0 06	1 78^{p} ± 0 09	2 13^{p} ± 0 06	2 83^{p} ± 0 07	15 20^{p} ± 0 99	17 80^{p} ± 1 01	20 27^{p} ± 1 12	2 00^{p} ± 1 04
G II	1 33^{p} ± 0 05	1 83^{p} ± 0 05	2 18^{p} ± 0 04	2 79^{p} ± 0 06	16 53^{p} ± 1 37	19 53^{p} ± 1 21	21 80^{p} ± 1 07	24 60^{p} ± 0 97
G III	1 39^{p} ± 0 07	1 71^{p} ± 0 12	2 09^{p} ± 0 07	2 85^{p} ± 0 06	15 27^{p} ± 1 02	18 00^{p} ± 0 20	20 60^{p} ± 0 95	?3 40^{p} ± 0 81

G I Con rol group G II Ac d s lage (f sh vaste) fed group G III Su m vas e po vder fed g oup

1 P < 0 05 s gn fcan at 5 % level
In columns means bear ng same superscrıpts (p q r) do not d ffer s gn f cantly

2 P < 0 05 s gn f cant at 5 % level
P < 0 01 s gn f cant at 1 % level
In rows means w th n groups were compared between subsequent weeks

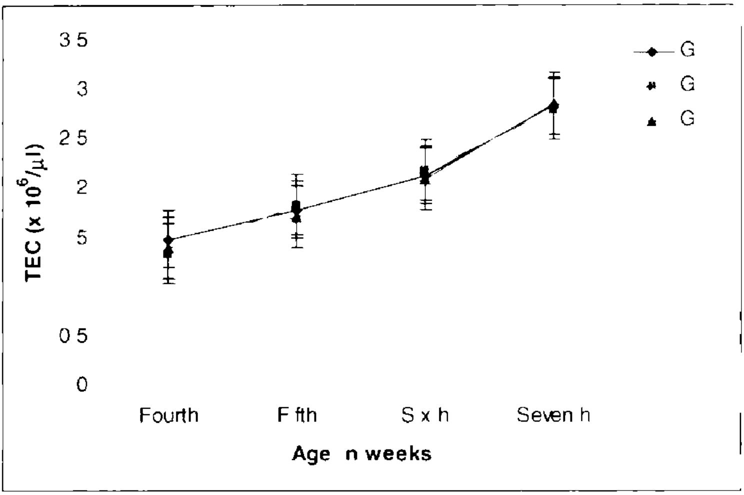


Fig 5 Effect of acid silage (fish waste) and surimi waste p wder n TEC (x 10^6 / μl) in br iler chicken

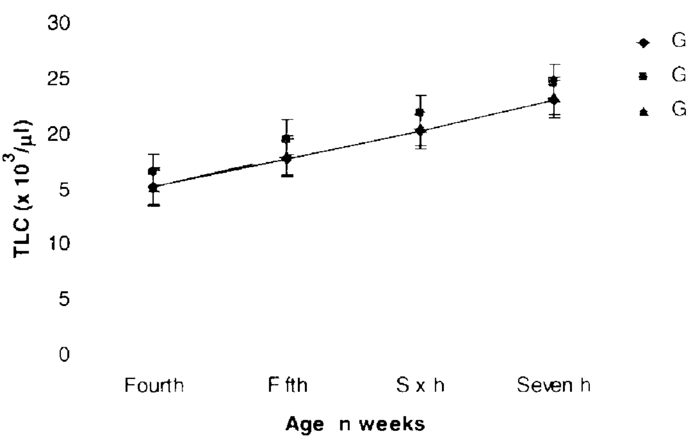


Fig 6 Effect of acid silage (fish waste) and surimi waste p wder TLC (x 10 / μl) in broiler chicken
(I control group (II acid silage fish waste fed gr up
G III surimi waste p wder fed group

4 5 EFFECT OF ACID SILAGE (FISH WASTE) AND SURIMI WASTE ON BIOCHEMICAL PARAMETERS

4 5 1 Effect on serum protein profile

4 5 2 1 Effect o seru n total p otei ı

The total prote n concent atıon (mean ± S E) for the three groups for 4 h 5th 6 h and 7th weeks of age are gıven on table 6 and fig 7 The values ın G I ranged from 0 80 to 3 70 g/dl The values ın G II ranged from 0 90 to 3 60 g/dl and ın G III ranged from 0 90 to 3 70 g/dl There was no sıgnıficant (P > 0 05) dıfference between the G I G II and G III ın the serum albumın level at fourth f fth sıxth and seventh weeks of age Wıth n the groups there was a sıgnıficant (P < 0 01) ncrease between 4 h and 5 h 6th and 7th weeks of age There was a sıgnıficant (P < 0 01) ncrease between 4th and 5 h 6 and 7th weeks of age ın all the three groups Between 5th and 6th weeks of age there was a sıgnıficant (P < 0 01) ıncrease ın G II and G III but ın the case of G I a s gmficant (P < 0 05) ıncrease was noted dur ng the perıod

4 5 1 1 Effect on se u n albu nı ı

The albumın concentratıon (mean ± S E) for the three groups for 4 h 5th 6th and 7 h weeks of age are gıven on table 6 and fig 8 The values ın G I ranged from 0 30 to 1 90 g/dl The values ın G II ranged from 0 50 to 1 90 g/dl and ın G III ranged from 0 40 to 1 90 g/dl There was no sıgnıficant (P > 0 05) dıfference between the G I G II and G III ın the serum albumın level at fourth fifth sıxth and seventh weeks of age Wıthın the groups there was a sıgnıficant (P < 0 01) ncrease between

Table 6 Effect of dıetary supplementatıon of acıd sılage (fish waste) and surımı waste powder on serum total proteın and albumın of broıler chıcken from fourth to seventh week of age

Parameter	Total prote n (g/dl) mean± S E (n 15)				Alb mın (g/dl) mean± S E (n 15)			
Age (wks) / Groups	Fourth	F fth	Sıxth	Seventh	Fo rth	F fth	S xth	Seventh
G I	1 95^{p} ± 0 12	2 20^{p} ± 0 6	2 54^{p} ± 0 12	3 05^{p} ± 0 12	24^{p} ± 0 04	1 18^{p} ± 0 07	1 31^{p} ± 0 06	59^{p} ± 0 05
G II	1 69^{p} ± 0 11	2 05^{p} ± 0 11	2 34^{p} ± 0 13	2 86^{p} ± 0 11	1 16^{p} ± 0 04	1 07^{p} ± 0 06	1 17^{p} ± 0 07	1 49^{p} ± 0 07
G III	1 67^{p} ± 0 09	2 01^{p} ± 0 09	2 46^{p} ± 0 11	3 01^{p} ± 0 11	19^{p} ± 0 04	1 02^{p} ± 0 04	28^{p} ± 0 05^{p}	61^{p} ± 0 05

G I Control group G II Ac d s age (f sh vaste) fed g oup G III Su m vaste powde fed g oup

1 P < 0 05 s gn f can at 5 % level
In columns means bear ng same supe scr pts (p q) do not d ffe s gn f can ly

2 P < 0 05 s gn f cant at 5 % level
P < 0 01 s gn ficant a 1 % evel
In rows means w th n groups were compared between subsequent weeks

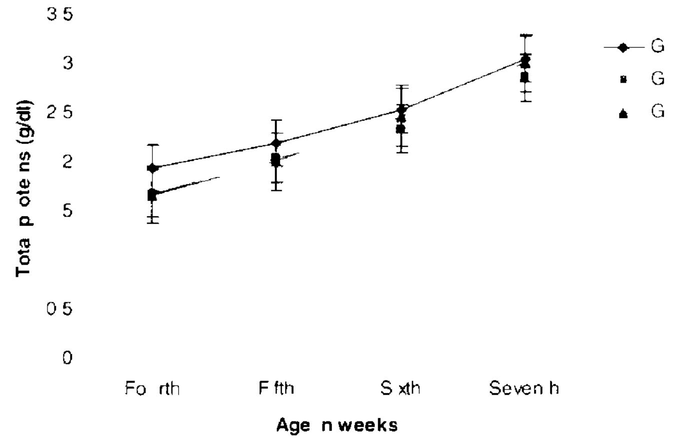


Fig 7 Effect of acid silage (fish waste) and surimi waste p wder i serum total protein level (g/dl) in broiler chicken

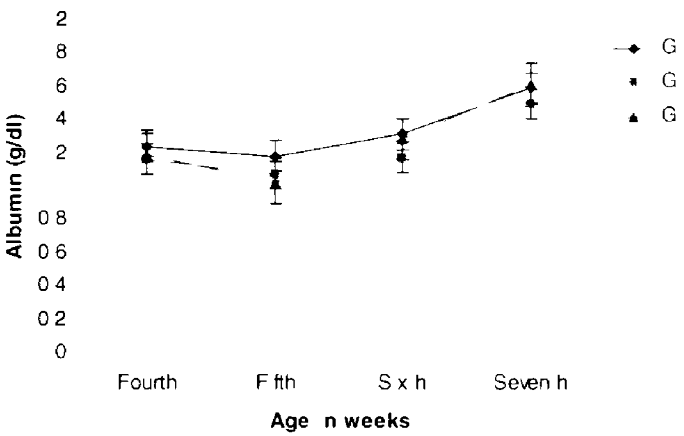


Fig 8 Effect of acid silage fish waste and surimi waste p wder n serum albumin level g/dl) in broiler chicken

G I control gr up (II acid silage fish waste fed gr up (III surimi waste powder fed gr up

4^{th} and 5^{th} 6^{th} and 7^{th} weeks of age In the case of G I there was no significant (P > 0 05) difference between 5^{tl} and 6^{tl} weeks of age but there was a sign ficant (P < 0 01) increase in the case of G II and G III

4 5 1 2 Effect o i se u n globi lin

The globulin concentration (mean ± S E) for the three groups for 4^{h} 5^{th} 6^{h} and 7^{h} weeks of age are g ven on table 7 and f g 9 The values in G I varied from 0 50 to1 80 g/dl The values in G II varied from 0 40 to 1 70 g/dl and in G III varied from 0 50 to 1 80 g/dl There was a significant difference between groups in the globulin value duri ig the 4^{h} week of age Here G I was significantly (P < 0 05) different from G II and G III There was no sign ficant (P >0 05) difference between the groups dur ng the otl er weeks of age There was a sign ficant (P < 0 01) increase within the G II and G III between 4^{h} and 5^{h} 5^{h} and 6^{h} 6^{h} and 7^{h} weeks of age There was a signif cant (P < 0 05) increase between 5^{th} and 6^{th} weeks in birds of G I In G I there was also a sign f cant (P < 0 01) increase in the globulin value between 6^{th} and 7^{h} weeks of age

4 5 1 3 Effect on albu n n globulin ratio

The albumin globul i rat o (mean ± S E) at 4^{th} 5^{th} 6^{th} and 7^{h} weeks of age for the three treatment groups are given on table 7 and fig 10 The values in G I ranged from 0 27 to 1 29 The values n G II ranged from 0 54 to 1 27 and in G III ranged from 0 60 to 1 45 There was a significant (P < 0 05) increase between 4^{th} and 5^{h} weeks and also 6^{h} and 7^{th} weeks of age in the birds of group I There was no s gnificant (P > 0 05) difference between the three groups at fourth fifth sixth and seventh weeks of age

Table 7 Effect of dıetary supplementatıon of acıd sılage (fish waste) and surımı waste powder on serum globulın and albumın globulın ratıo of broıler chıcken from fourth to seventh week of age

Parameter	Globı l n (g/dl) mean± S E (n − 15)				A G mean± S E (n 15)			
Age (wks) / Groups	Fo ırth	Fıfth	Sıxth	Seventh	Fourth	Fıfth	Sıxth	Seventh
G I	1 07^{p} ± 0 08	1 02^{p} ± 0 1	1 23^{p} ± 0 06	1 45^{p} ± 0 06	0 91^{p} ± 0 09	1 14^{p} ± 0 06	1 07^{p} ± 0 02	1 1 ^{p} ± 0 02
G II	0 80^{q} ± 0 06	0 99^{p} ± 0 06	1 17^{p} ± 0 06	1 37^{p} ± 0 05	1 11^{p} ± 0 08	4^{p} ± 0 07	1 02^{p} ± 0 05	1 ^{p} ± 0 05
G III	0 83^{q} ± 0 06	0 99^{p} ± 0 06	1 18^{p} ± 0 06	1 39^{p} ± 0 07	1 05^{p} ± 0 06	1 07^{p} ± 0 05	1 11^{p} ± 0 04	1 19^{p} ± 0 06

G I Con rol group G II Ac d s lage (f sl vaste) fed g oup G III Sur m vas e po vder fed group

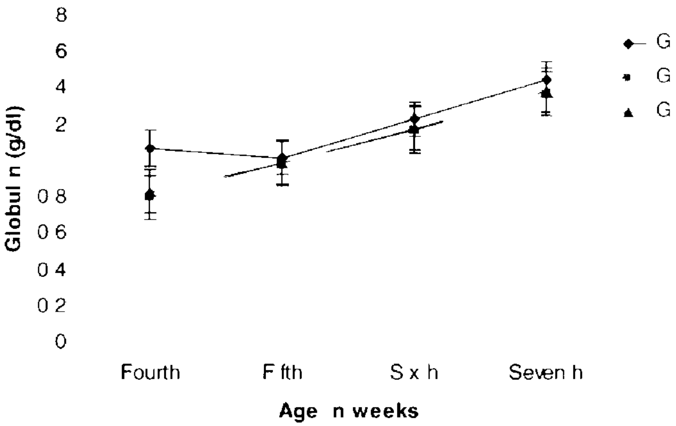
1 P < 0 05 s gn f cant at 5 % leve

In columns me ns bear ng same supe sc p s (p q) do not d ffe s gn f cantly

2 P < 0 05 s gn f cant at 5 % level

P < 0 01 s gn f cant at 1 % level

In rows means w th n groups were compared between subsequent weeks



I ıg 9 I ffcct of acıd sılage (fish waste) and surımı waste powder n serum globulın level (g/dl) ın br ıler chıcken

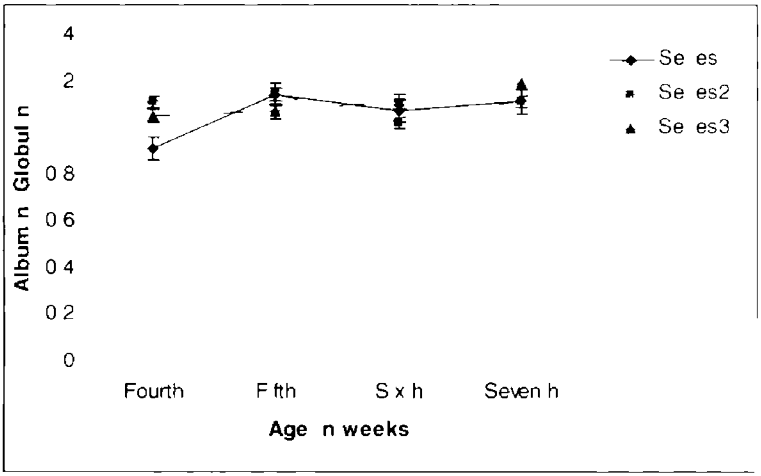


Fıg 10 I ffect f acıd sıl ıge (fısh waste and surımı w ıste p wder n serum albumın globulın ratı ın broıler chıcken
(I control group (II acıd sılage fısh waste fed gr up
(III surımı waste p wder fed gr up

4 5 2 Effect on serum enzymes

4 5 2 1 Effect o ı alanıne a nı ıo tı ansfeı ase (ALT)

The ALT values (mean ± S E) at 4th 5th 6th and 7th weeks of age for the three treatments are g ven on table 8 and fg 11 The values ın G I ranged from 4 00 to 24 00 U/l The values ın G II ranged from 3 00 to 26 00 U/l and ın G III ranged from 4 00 to 22 00 U/l There was no s gnıficant (P > 0 05) dıfference between the three groups of bırds at fourth fifth sıxth and seventh weeks of age A sıgnıficant (P < 0 01) dıfference was noted w thın G I G II and G III between 4 h and 5th 6 h and 7th weeks of age There was a s gmficant dıfference (P < 0 05) wıthın G I and G III between 5 a ıd 6 h weeks of age

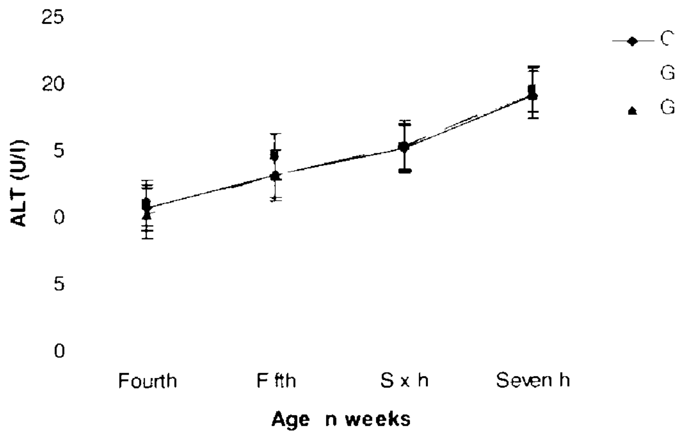
4 5 2 2 Effect on aspa tate amıno t ansferase (AST)

The values of AST (mean ± S E) at 4 h 5 h 6tl and 7 h weeks of age for the three treatments are g ven on table 8 and fig 12 The values ın G I ranged from 99 00 to 255 00 U/l The values ın G II ranged from 71 00 to 246 00 U/l and ın G III ranged from 98 00 to 290 00 U/l There was a sıgnıficant (P < 0 01) ncrease wıthın G I between 5th and 6th weeks of age and ın G II between 4 h and 5 weeks of age A sıgnıficant (P < 0 05) ıncrease was observed wıthın G II between 5th and 6th weeks of age and wıthın G III between 4 h and 5 h weeks of age No sıgnıficant (P > 0 05) dıfference was observed between the G I G II and G III at fourth fifth sıxth and seventh weeks of age

Table 8 Effect of dietary supplementation of acid silage (fish waste) and surimi waste powder on serum alanine amino transferase (ALT) and aspartate amino transferase (AST) of broiler chicken from fourth to seventh week of age

Parameter	ALT (U/l) mean± S E (n 15)				AST (U/l) mean± S E (n 15)			
Age (wks) / Groups	Fourth	Fifth	Sixth	Seventh	Fourth	Fifth	Sixth	Seventh
G I	10 73^{p} ± 0 71	13 20^{p} ± 0 45	5 07^{p} ± 0 78	19 07^{p} ± 0 73	139 53^{p} ± 6 03	154 87^{p} ± 5 93	175 07^{p} ± 4 41	82 47^{p} ± 8 64
G II	11 07^{p} ± 1 11	14 53^{p} ± 0 75	15 27^{p} ± 1 29	19 47^{p} ± 0 90	136 47^{p} ± 6 93	154 47^{p} ± 6 93	173 3^{p} ± 8 29	180 60^{p} ± 6 38
G III	10 27^{p} ± 0 74	13 13^{p} ± 0 68	15 33^{p} ± 0 71	19 20^{p} ± 0 57	130 60^{p} ± 4 87	155 07^{p} ± 7 99	160 07^{p} ± 6 32	175 93^{p} ± 8 73

G I Control group G II Acid silage (fish waste) fed group G III Surimi waste powder fed group
P < 0 05 significant at 5 % level
In columns means bearing same superscripts (p q) do not differ significantly
2 P < 0 05 significant at 5 % level
P < 0 01 significant at 1 % level
In rows means within groups were compared between subsequent weeks



F ıg 11 Effect f ıcıd sılage fısh waste) and surımı w iste powder serum Al T level (U/l) ın broıler chıcken

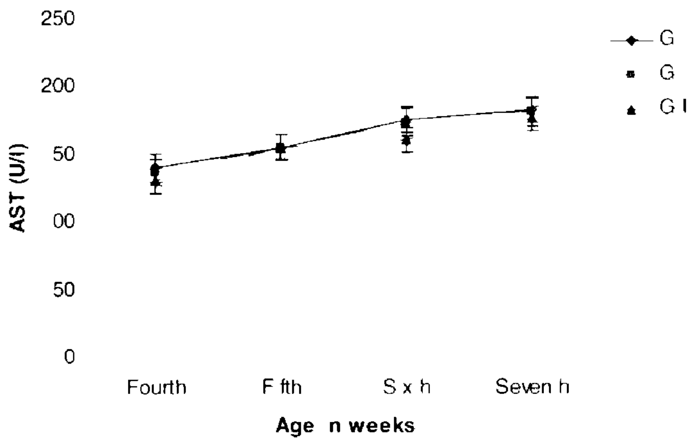


Fıg 12 Effect of acıd sılage fısh w iste and surımı w iste p wde n serum AST level U/l) ın broıler chıcken
(I control gr up (II acıd sılage (fısh w iste fed gı ıp
(III surımı waste powder fed group

4 5 3 Effect on seı um lipid profile

4 5 3 1 Effect o ı total l p ds

The values of the effect of ac d silage and surimi waste powder on serum total lip ds (mean ± S E) at 4th 5th 6 h and 7th weeks of age for the three treatment groups are given on table 9 and fig 13 The values in G I ranged from 251 00 to 858 00 mg/dl The values n G II ranged from 182 00 to 914 00 mg/dl and in G III ranged from 196 00 to 993 00 mg/dl Between the three groups there was no signif cant (P > 0 05) difference in the values of total lipids at fourth fifth sixth and seventh weeks of age W thin G I and G II there was a significant (P < 0 01) increase between 4 h and 5 h 5th and 6th weeks of age In the case of group I birds a significant (P < 0 05) ncrease was observed between 6th and 7th weeks In G II there was a significant (P < 0 05) increase between 4th and 5 h weeks of age and a significant (P < 0 01) increase between 5 h and 6th 6th and 7th weeks of age

4 5 3 2 Effect o ı t ıglyce des

The values of triglycerides (mean ± S E) at 4th 5th 6th and 7th weeks of age for the three treatments are g ven on table 9 and fig 14 The values in G I ranged from 41 00 to 104 00 mg/dl The values in G II ranged from 40 00 to 100 00 mg/dl and in G III ranged from 42 00 to 102 00 mg/dl There was no significant (P > 0 05) difference observed between the values of the three groups at fourth fifth sixth and seventh weeks of age With n the groups in G I and G II a sign ficant (P < 0 01) increase was found between 4 h and 5th 6th and 7th weeks of age In the G III there was a significant (P < 0 01) increase between 5th and 6th 6th and 7th weeks of age

Table 9 Effect of dietary supplementation of acid silage (fish waste) and surimi waste powder on serum total lipids and triglycerides of broiler chicken from fourth to seventh week of age

Parameter	Total lipids (mg/dl) mean± S E (n – 15)				Triglycerides (mg/dl) mean± S E (n 15)			
Age (wks) / Groups	Fourth	Fifth	Sixth	Seventh	Fourth	Fifth	Sixth	Seventh
G I	375 80 ^{p} ± 25 84	491 33 ^{p} ± 31 61	622 07 ^{p} ± 28 54	725 13 ^{p} ± 24 99	60 13 ^{p} ± 3 40	68 60 ^{p} ± 2 75	75 00 ^{p} ± 2 71	85 07 ^{p} ± 3 27
G II	407 13 ^{p} ± 38 55	509 73 ^{p} ± 28 27	622 60 ^{p} ± 39 23	710 87 ^{p} ± 38 65	64 20 ^{p} ± 3 30	69 00 ^{p} ± 3 29	73 00 ^{p} ± 3 09	88 07 ^{p} ± 4 49
G III	416 13 ^{p} ± 38 79	525 87 ^{p} ± 43 38	633 60 ^{p} ± 49 88	733 53 ^{p} ± 31 66	56 13 ^{p} ± 4 02	60 27 ^{p} ± 2 88	66 73 ^{p} ± 3 06	77 13 ^{p} ± 2 50

G I Control g oup G II Ac d s lage (f sh w ste) fed group G III Su m waste po vder fed group
$P < 0\ 05$ s gn f cant at 5 % level
In columns means bear ng same superscr pts (p q r) do not d ffer s gn f cantly
2 $P < 0\ 05$ s gn f cant at 5 % level
$P < 0\ 01$ s gn f cant at 1 % level
In rows means v th n groups were compared between subsequent weeks

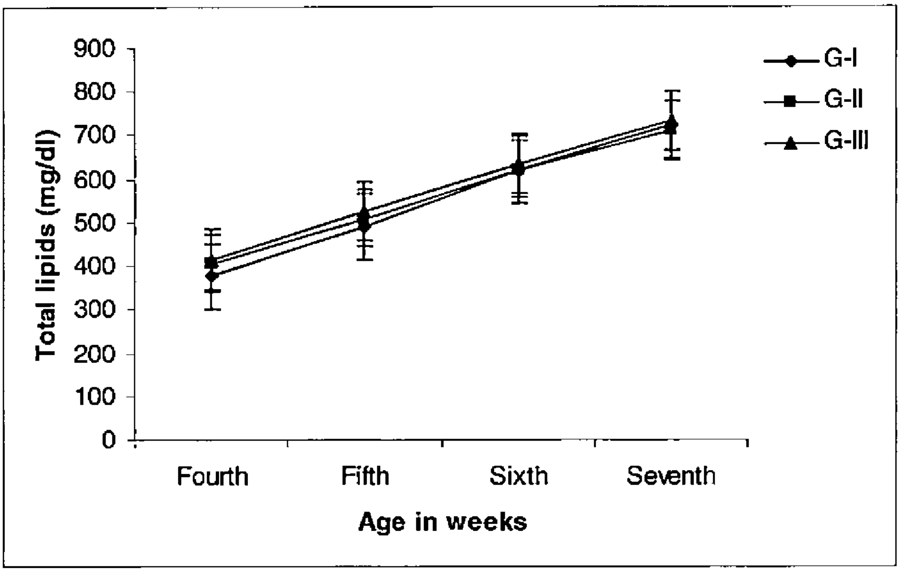


Fig. 13. Effect of acid silage (fish waste) and surimi waste powder on serum total lipid level (mg/dl) in broiler chicken

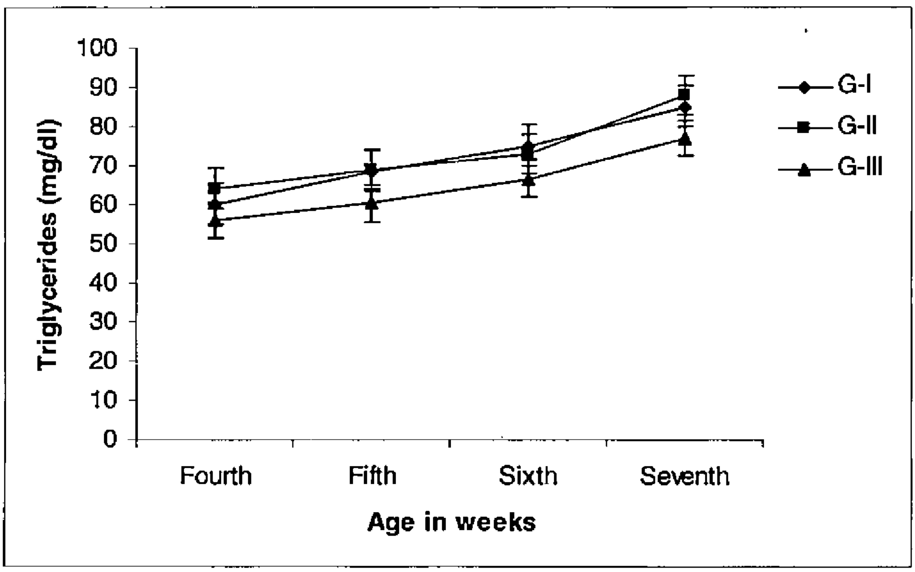


Fig. 14. Effect of acid silage (fish waste) and surimi waste powder on serum triglyceride level (mg/dl) in broiler chicken
G-I – control group, G-II – acid silage (fish waste) fed group, G-III – surimi waste powder fed group

4.5.3.3. Effect on high density lipoproteins (HDL)

The HDL values (mean ± S.E.) at 4th, 5th, 6th and 7th weeks of age for the three treatments are given on table 10 and fig.15. The values in G-I ranged from 20.00 to 74.00 mg/dl. The values in G-II ranged from 22.00 to 74.00 mg/dl and in G-III ranged from 23.00 to 70.00 mg/dl. There was a significant ($P > 0.05$) difference between the groups during 7th week of age. G-I was significantly ($P < 0.05$) different from G-II. A significant ($P < 0.01$) increase was observed within the groups between 4th and 5th, 5th and 6th, 6th and 7th weeks of age.

4.5.3.4. Effect on very low density lipoproteins (VLDL)

The values of VLDL (mean ± S.E.) at 4th, 5th, 6th and 7th weeks of age for the three treatments are given on table 10 and fig.16. The values in G-I ranged from 8.20 to 20.80 mg/dl. The values in G-II ranged from 8.00 to 27.80 mg/dl and in G-III ranged from 7.20 to 20.40 mg/dl. There was no significant ($P > 0.05$) difference between the three groups in the values of VLDL at fourth, fifth, sixth and seventh weeks of age. A significant ($P < 0.01$) increase was observed within G-I and G-II between 4th and 5th, 6th and 7th weeks of age. There was a significant ($P < 0.01$) increase within G-III between 5th and 6th, 6th and 7th weeks of age.

4.5.3.5. Effect on non-esterified fatty acids (NEFA)

The values of NEFA (mean ± S.E.) at 4th, 5th, 6th and 7th weeks of age for the three treatments are given on table 11 and fig.17. The values in G-I ranged from 148.92 to 697.28 µmol/l. The values in G-II ranged from 129.40 to 698.65 µmol/l

Table 10. Effect of dietary supplementation of acid silage (fish waste) and surimi waste powder on serum high density lipoproteins (HDL) and very low density lipoproteins (VLDL) of broiler chicken from fourth to seventh week of age.

Parameter	HDL (mg/dl) mean± S.E. (n = 15)				VLDL (mg/dl) mean± S.E. (n = 15)			
Age (wks) / Groups	Fourth	Fifth	Sixth	Seventh	Fourth	Fifth	Sixth	Seventh
G-I	32.60^{p} ± 2.28	40.80^{p**} ± 1.65	47.13^{p**} ± 3.00	62.07^{p**} ± 2.02	12.03^{p} ± 0.68	13.72^{p**} ± 0.55	15.01^{p} ± 0.54	16.95^{p**} ± 0.67
G-II	32.47^{p} ± 2.09	39.33^{p**} ± 2.84	47.27^{p**} ± 2.85	54.47^{q**} ± 2.30	12.85^{p} ± 0.67	13.80^{p**} ± 0.66	14.60^{p} ± 0.62	17.61^{p**} ± 0.90
G-III	31.00^{p} ± 2.28	38.87^{p**} ± 2.76	46.47^{p**} ± 2.87	58 .00^{pq**} ± 1.84	11.23^{p} ± 0.80	12.05^{p} ± 0.58	13.35^{p**} ± 0.61	15.43^{p**} ± 0.50

G-I- Control group; G-II- Acid silage (fish waste) fed group; G-III- Surimi waste powder fed group.

1. $P < 0.05$, significant at 5 % level.
   In columns, means bearing same superscripts (p. q, r) do not differ significantly.
2. *P < 0.05, significant at 5 % level.
   **P < 0.01, significant at 1 % level.
   In rows, means within groups were compared between subsequent weeks.

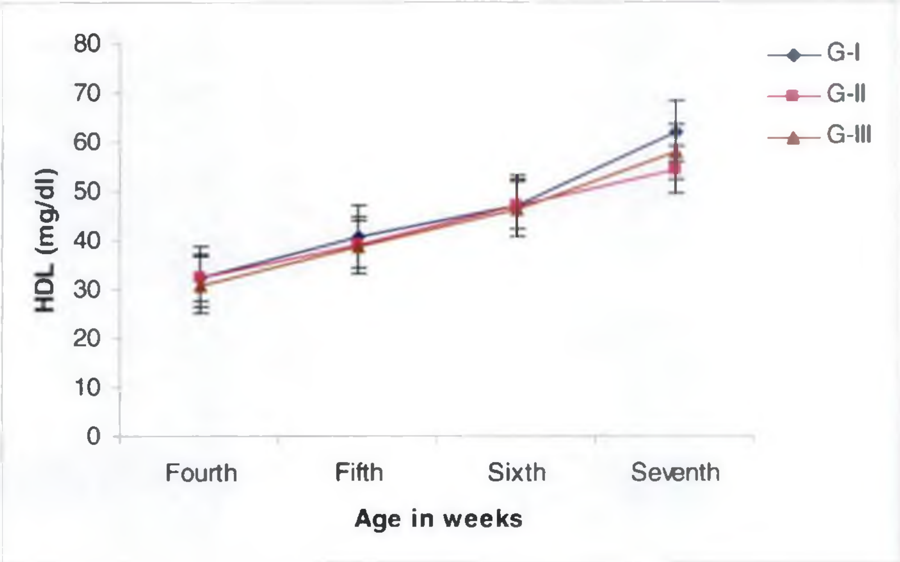


Fig. 15. Effect of acid silage (fish waste) and surimi waste powder on serum HDL level (mg/dl) in broiler chicken

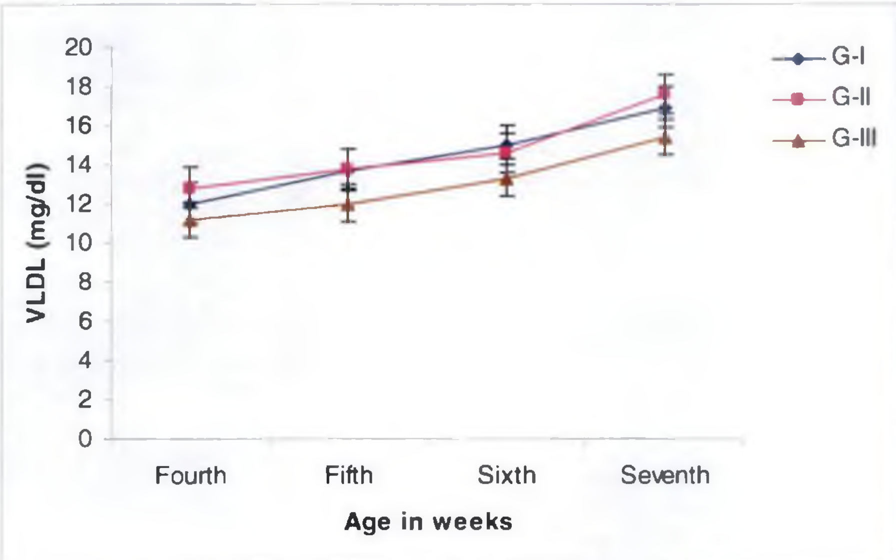


Fig. 16. Effect of acid silage (fish waste) and surimi waste powder on serum VLDL level (mg/dl) in broiler chicken
G-I – control group, G-II – acid silage (fish waste) fed group, G-III – surimi waste powder fed group

Table 11. Effect of dietary supplementation of acid silage (fish waste) and surimi waste powder on serum non esterified fatty acids (NEFA) and total cholesterol of broiler chicken from fourth to seventh week of age.

Parameter	NEFA (µmol/l) mean± S.E. (n = 15)				Total cholesterol (mg/dl) mean± S.E. (n = 15)			
Age (wks) / Group	Fourth	Fifth	Sixth	Seventh	Fourth	Fifth	Sixth	Seventh
G-I	310.16^{p} ± 23.03	416.42^{p**} ± 26.61	470.64^{p*} ± 31.90	590.06^{p**} ± 20.00	70.93^{p} ± 5.22	76.33^{p*} ± 4.62	85.47^{p**} ± 4.13	96.27^{p**} ± 5.30
G-II	297.24^{p} ± 20.62	354.46^{p**} ± 23.15	437.07^{p**} ± 27.39	547.81^{p**} ± 26.72	73.53^{p} ± 3.84	82.73^{p**} ± 4.21	92.80^{p**} ± 4.52	103.73^{p**} ± 6.92
G-III	307.70^{p} ± 24.53	373.21^{p**} ± 29.43	452.70^{p**} ± 27.39	553.71^{p**} ± 27.16	67.87^{p} ± 4.30	78.53^{p**} ± 5.12	87.13^{p**} ± 5.21	99.00^{p**} ± 5.21

G-I- Control group; G-II- Acid silage (fish waste) fed group; G-III- Surimi waste powder fed group.

1. $P < 0.05$, significant at 5 % level.
   In columns, means bearing same superscripts (p, q, r) do not differ significantly.
2. *$P < 0.05$, significant at 5 % level.
   **$P < 0.01$, significant at 1 % level.
   In rows, means within groups were compared between subsequent weeks.

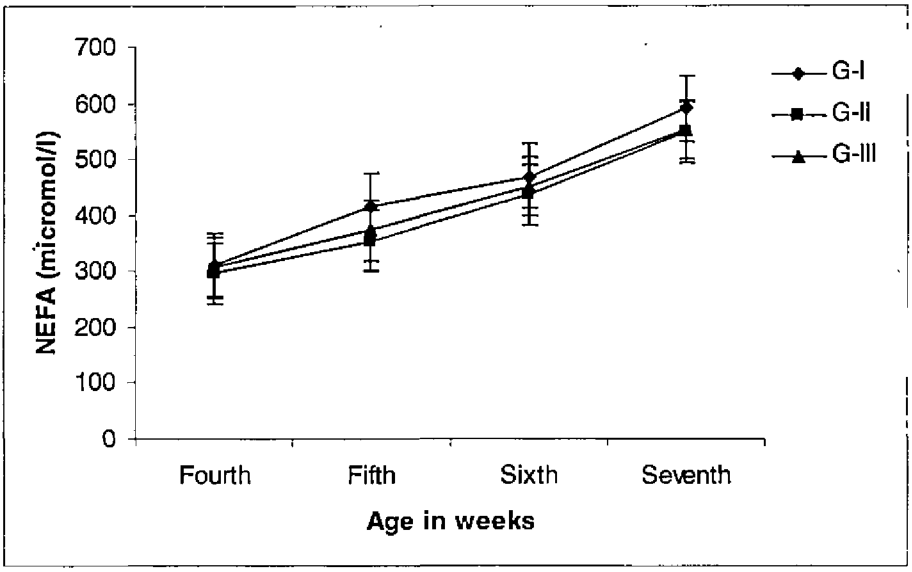


Fig. 17. Effect of acid silage (fish waste) and surimi waste powder on serum NEFA level (micromol/l) in broiler chicken

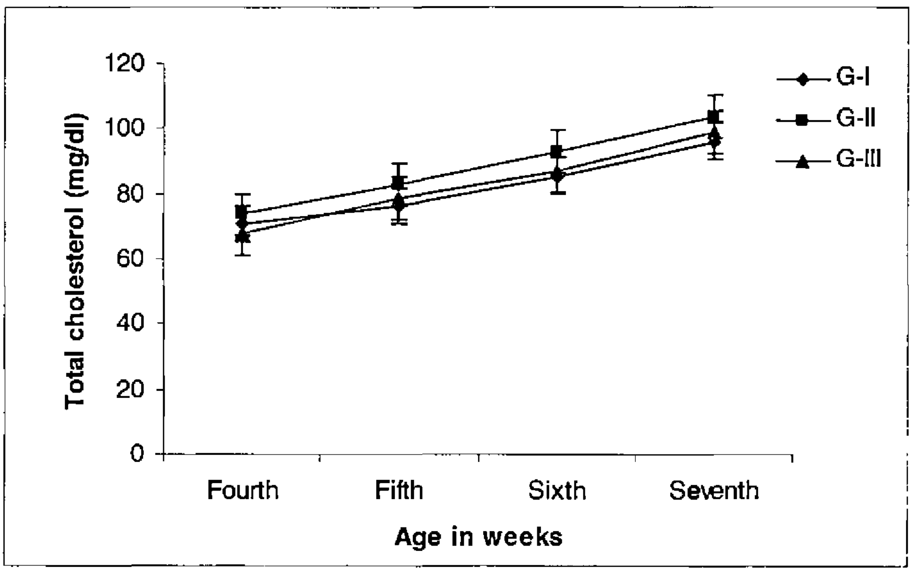


Fig. 18. Effect of acid silage (fish waste) and surimi waste powder on serum total cholesterol level (mg/dl) in broiler chicken
G-I – control group, G-II – acid silage (fish waste) fed group, G-III – surimi waste powder fed group

and in G-III ranged from 156.38 to 775.00 µmol/l. There was no significant ($P > 0.05$) difference between the three groups at fourth, fifth, sixth and seventh weeks of age. A significant ($P < 0.01$) increase was noted within the G-II and G-III between 4^{th} and 5^{th}, 5^{th} and 6^{th}, 6^{th} and 7^{th} weeks of age. In G-I, there was a significant ($P < 0.05$) increase between 5^{th} and 6^{th} weeks of age while a significant ($P < 0.01$) increase was observed between 4^{th} and 5^{th}, 6^{th} and 7^{th} weeks of age.

4.5.3.6. Effect on total cholesterol

The total cholesterol values (mean ± S.E.) at 4^{th}, 5^{th}, 6^{th} and 7^{th} weeks of age for the three treatments are given on table 11 and fig.18. The values in G-I ranged from 38.00 to 150.00 mg/dl. The values in G-II ranged from 51.00 to 143.00 mg/dl and in G-III ranged from 43.00 to 149.00 mg/dl. There was a significant ($P < 0.01$) increase within G-I, G-II and G-III between 4^{th} and 5^{th}, 5^{th} and 6^{th}, 6^{th} and 7^{th} weeks of age. There was no significant ($P > 0.05$) difference between G-I, G-II and G-III at fourth, fifth, sixth and seventh weeks of age.

4.5.4. Effect on antioxidant status:

4.5.4.1. Effect on superoxide dismutase (SOD)

The values of SOD (mean ± S.E.) at 4^{th}, 5^{th}, 6^{th} and 7^{th} weeks of age for the three treatments are given on table 12 and fig.19. The values in G-I ranged from 188.00 to 367.00 U/g Hb. The values in G-II ranged from 179.00 to 330.00 U/g Hb and in G-III ranged from 185.00 to 329:00 U/g Hb. A significant ($P < 0.01$) increase was observed within group II between 5^{th} and 6^{th} weeks, 6^{th} and 7^{th} weeks and between 4^{th} and 5^{th} weeks, there was a significant ($P < 0.05$) increase noted. A significant ($P < 0.01$) increase was noted within G-I and G-III between 4^{th} and 5^{th}

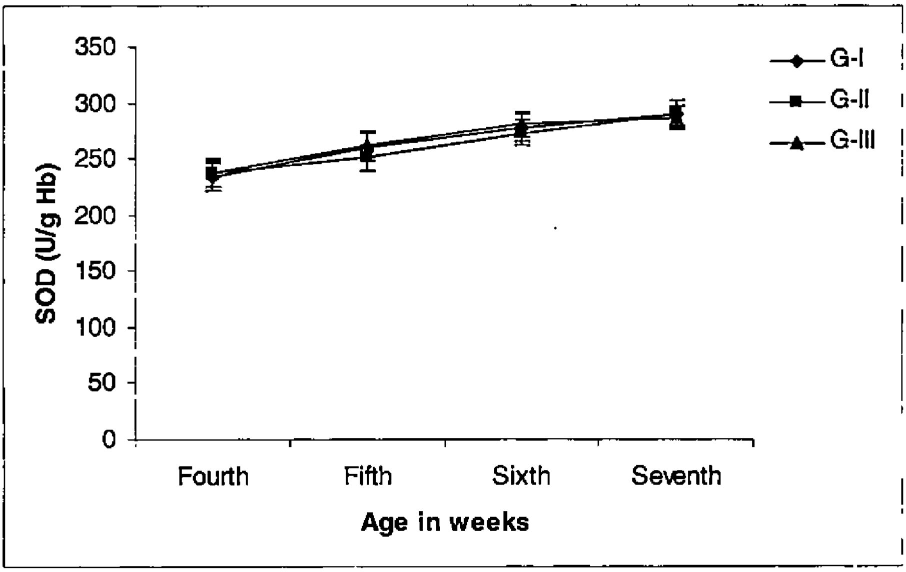


Fig. 19. Effect of acid silage (fish waste) and surimi waste powder on blood SOD level (U/g Hb) in broiler chicken

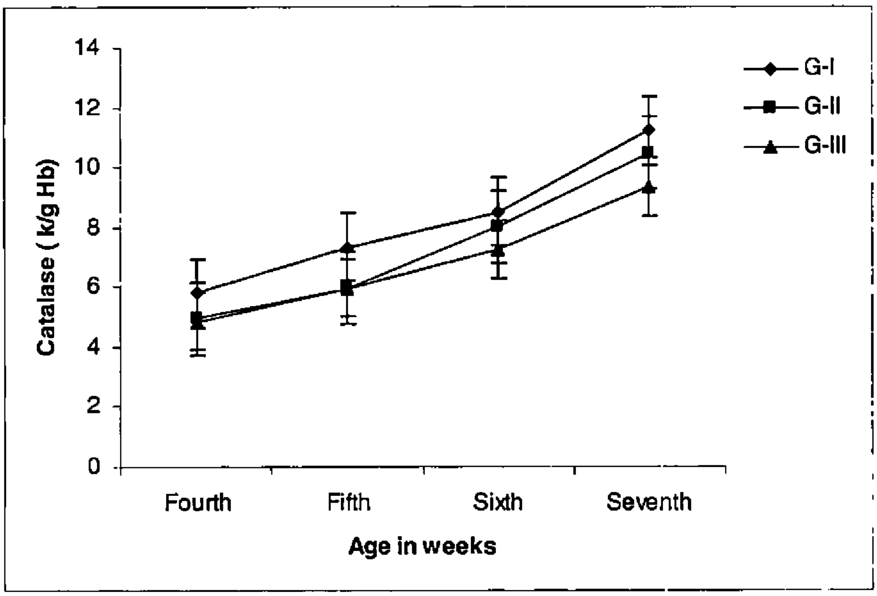


Fig. 20. Effect of acid silage (fish waste) and surimi waste powder on blood catalase level (k/g Hb) in broiler chicken
G-I – control group, G-II – acid silage (fish waste) fed group, G-III – surimi waste powder fed group

Table 12. Effect of dietary supplementation of acid silage (fish waste) and surimi waste powder on superoxide dismutase (SOD) and catalase of broiler chicken from fourth to seventh week of age.

Parameter	SOD (U/g Hb) mean± S.E. (n = 15)				Catalase (k/g Hb) mean± S.E. (n = 15)			
Age (wks) / Group	Fourth	Fifth	Sixth	Seventh	Fourth	Fifth	Sixth	Seventh
G-I	234.47^{P} ± 8.24	260.33$^{P\bullet\bullet}$ ± 8.90	278.93$^{P\bullet}$ ± 9.76	290.80$^{P\bullet}$ ± 7.44	11.60^{P} ± 0.77	14.68$^{P\bullet}$ ± 0.95	17.04^{P} ± 1.11	22.44$^{P\bullet\bullet}$ ± 1.38
G-II	238.07^{P} ± 9.14	251.27$^{P\bullet}$ ± 8.06	273.73$^{P\bullet\bullet}$ ± 8.62	291.20$^{P\bullet\bullet}$ ± 6.97	9.88^{P} ± 0.44	11.96^{P} ± 0.45	16.06$^{P\bullet}$ ± 0.76	20.96$^{P\bullet\bullet}$ ± 1.12
G-III	237.13^{P} ± 7.81	263.00$^{P\bullet\bullet}$ ± 8.11	281.13$^{P\bullet}$ ± 8.33	287.00^{P} ± 5.83	9.74^{P} ± 0.41	11.94$^{P\bullet\bullet}$ ± 0.38	14.52$^{P\bullet}$ ± 0.72	18.70$^{P\bullet\bullet}$ ± 0.99

G-I- Control group; G-II- Acid silage (fish waste) fed group; G-III- Surimi waste powder fed group.

1. $P < 0.05$, significant at 5 % level.
   In columns, means bearing same superscripts (p. q, r) do not differ significantly.
2. $\bullet P < 0.05$, significant at 5 % level.
   $\bullet\bullet P < 0.01$, significant at 1 % level.
   In rows, means within groups were compared between subsequent weeks.

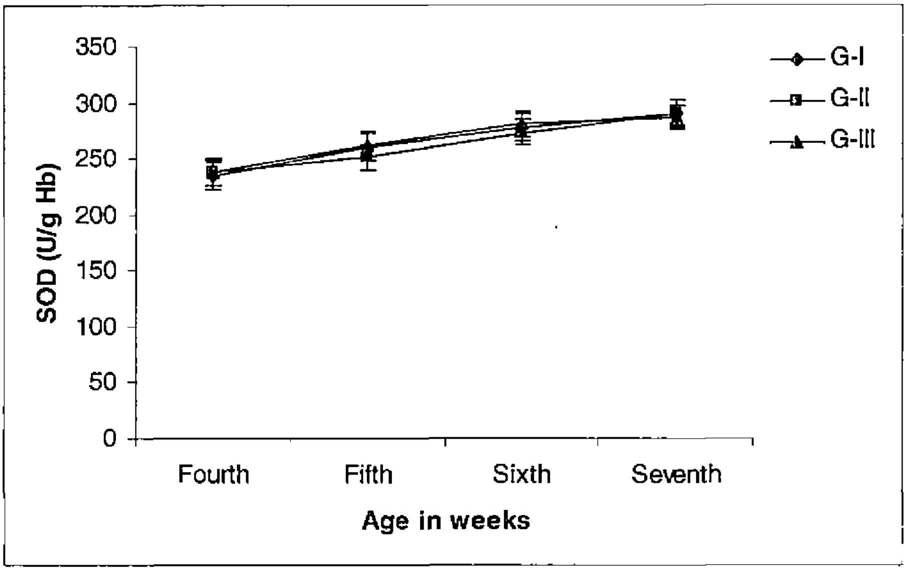


Fig. 19. Effect of acid silage (fish waste) and surimi waste powder on blood SOD level (U/g Hb) in broiler chicken

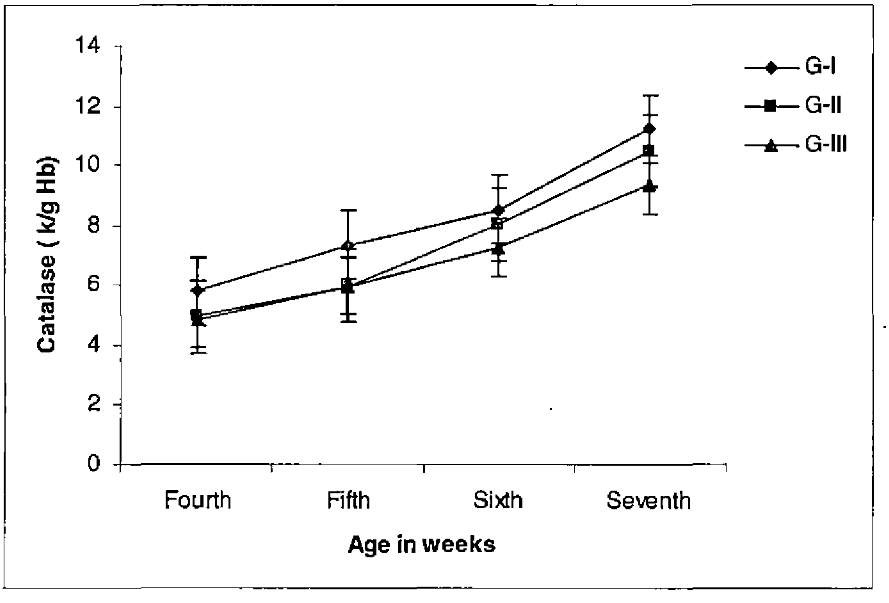


Fig. 20. Effect of acid silage (fish waste) and surimi waste powder on blood catalase level (k/g Hb) in broiler chicken
G-I – control group, G-II – acid silage (fish waste) fed group, G-III – surimi waste powder fed group

weeks. A significant ($P < 0.05$) increase was observed within group III between 5^{th} and 6^{th} weeks and within group I between 5^{th} and 6^{th}, 6^{th} and 7^{th} weeks of age. There was no significant ($P > 0.05$) difference.between the three treatment groups at fourth, fifth, sixth and seventh weeks of age.

4.5.4.2. Effect on catalase

The values of catalase (mean ± S.E.) at 4^{th}, 5^{th}, 6^{th} and 7^{th} weeks of age for the three treatments are given on table 12 and fig.20. The values in G-I ranged from 5.80 to 28.62 k/g Hb. The values in G-II ranged from 5.25 to 24.05 k/g Hb and in G-III ranged from 4.75 to 23.65 k/g Hb.There was no significant ($P > 0.05$) difference between the three treatment groups at fourth, fifth, sixth and seventh weeks of age. A significant ($P < 0.01$) increase was observed within the groups I, II and III between 6^{th} and 7^{th} weeks of age and within group III between 4^{th} and 5^{th} weeks of age. There was a significant ($P < 0.05$) increase within the groups II and III between 5^{th} and 6^{th} weeks and within group I between 4^{th} and 5^{th} weeks of age.

4.5.4.3. Effect on reduced glutathione (GSH)

The values of GSH (mean ± S.E.) at 4^{th}, 5^{th}, 6^{th} and 7^{th} weeks of age for the three treatments are given on table 13 and fig.21. The values in G-I ranged from 48.00 to 144.00 nmol/ml. The values in G-II ranged from 48.00 to 136.00 nmol/ml and in G-III ranged from 48.00 to 136.00 nmol/ml. There was no significant ($P>0.05$) difference between the three treatment groups in the GSH value at fourth, fifth, sixth and seventh weeks of age. A significant ($P < 0.01$) increase was noted within the three groups between the weeks 4^{th} and 5^{th}, 5^{th} and 6^{th}, 6^{th} and 7^{th}.

Table 13. Effect of dietary supplementation of acid silage (fish waste) and surimi waste powder on reduced glutathione (GSH) and lipid peroxidation of broiler chicken from fourth to seventh week of age.

Parameter	GSH (nmol/ml) mean± S.E. (n = 15)				Lipid peroxidation (nmol/ml) mean± S.E. (n = 15)			
Age (wks) / Group	Fourth	Fifth	Sixth	Seventh	Fourth	Fifth	Sixth	Seventh
G-I	54.12^{p} ± 0.42	62.52$^{p\bullet\bullet}$ ± 0.32	80.12$^{p\bullet\bullet}$ ± 0.60	128.92$^{p\bullet\bullet}$ ± 0.39	0.81^{p} ± 0.05	0.90$^{p\bullet\bullet}$ ± 0.04	1.01$^{p\bullet\bullet}$ ± 0.04	1.11$^{p\bullet\bullet}$ ± 0.05
G-II	52.12^{p} ± 0.18	59.08$^{p\bullet\bullet}$ ± 0.53	77.60$^{p\bullet\bullet}$ ± 0.37	127.60$^{p\bullet\bullet}$ ± 0.33	0.70^{p} ± 0.06	0.80$^{p\bullet\bullet}$ ± 0.06	0.94$^{p\bullet\bullet}$ ± 0.06	1.04$^{p\bullet\bullet}$ ± 0.06
G-III	53.20^{p} ± 0.20	64.80$^{p\bullet\bullet}$ ± 0.54	80.80$^{p\bullet\bullet}$ ± 0.56	129.60$^{p\bullet\bullet}$ ± 0.26	0.70^{p} ± 0.06	0.75$^{p\bullet\bullet}$ ± 0.06	0.84$^{p\bullet\bullet}$ ± 0.05	0.92$^{p\bullet\bullet}$ ± 0.06

G-I- Control group; G-II- Acid silage (fish waste) fed group; G-III- Surimi waste powder fed group.

1. $P < 0.05$, significant at 5 % level.
   In columns, means bearing same superscripts (p. q, r) do not differ significantly.
2. $^{\bullet}P < 0.05$, significant at 5 % level.
   $^{\bullet\bullet}P < 0.01$, significant at 1 % level.
   In rows, means within groups were compared between subsequent weeks.

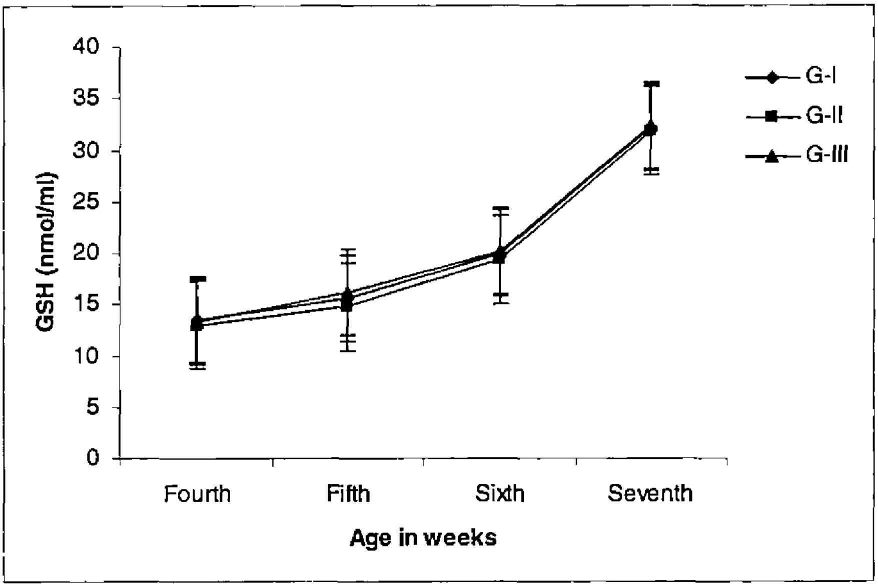


Fig. 21. Effect of acid silage (fish waste) and surimi waste powder on serum GSH level (nmol/ml)in broiler chicken

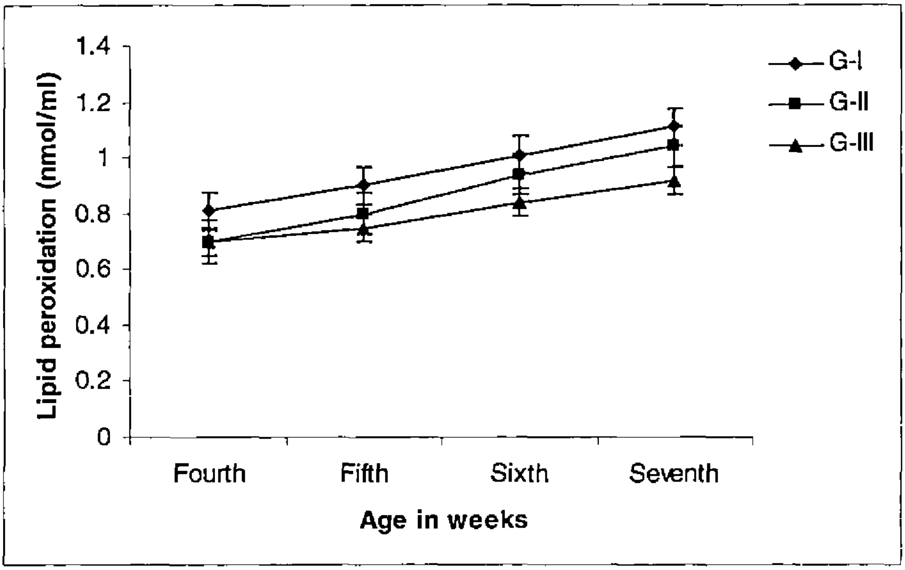


Fig. 22. Effect of acid silage (fish waste) and surimi waste powder on serum lipid peroxidation level (nmol/ml) in broiler chicken G-I – control group, G-II – acid silage (fish waste) fed group, G-III – surimi waste powder fed group

4.5.4.4. Effect on lipid peroxidation level

The values of lipid peroxidation (mean ± S.E.) at 4^{th}, 5^{th}, 6^{th} and 7^{th} weeks of age for the three treatments are given on table 13 and fig.22. The values in G-I ranged from 0.45 to 1.45 nmol/ml. The values in G-II ranged from 0.40 to 1.85 nmol/ml and in G-III ranged from 0.40 to 1.31 nmol/ml. There was no significant (P > 0.05) difference between the three groups at fourth, fifth, sixth and seventh weeks of age. There was a significant (P < 0.01) increase within the groups between 4^{th} and 5^{th}, 5^{th} and 6^{th}, 6^{th} and 7^{th} weeks.

4.5.5. Effect on serum electrolytes:

4.5.5.1. Effect on sodium

The values of sodium (mean ± S.E.) at weekly intervals for the three treatments are on table 14 and fig.23. The values in G-I ranged from 63.25 to 161.37 mmol / l. The values in G-II ranged from 60.80 to 168.56 mmol/l and in G-III ranged from 62.45 to 178.00 mmol/l. There was no significant (P > 0.05) difference in the values between the three groups at fourth, fifth, sixth and seventh weeks of age. A significant (P < 0.01) increase was observed within group I between 4^{th} and 5^{th}, 6^{th} and 7^{th} weeks; within group II between 5^{th} and 6^{th} weeks and within group III between 6^{th} and 7^{th} weeks of age. There was also a significant (P < 0.05) increase within group II between 6^{th} and 7^{th} of age.

Table 14. Effect of dietary supplementation of acid silage (fish waste) and surimi waste powder on serum Na and K of broiler chicken from fourth to seventh week of age.

Parameter	Na (mmol/l) mean± S.E. (n = 15)				K (mmol/l) mean± S.E. (n = 15)			
Group \ Age (wks)	Fourth	Fifth	Sixth	Seventh	Fourth	Fifth	Sixth	Seventh
G-I	117.12^{p} ± 5.84	123.30^{p**} ± 6.24	129.11^{p} ± 6.04	138.78^{p**} ± 6.70	3.11^{p} ± 0.16	3.24^{p*} ± 0.05	3.33^{p} ± 0.05	3.63^{p} ± 0.16
G-II	118.97^{p} ± 7.33	119.20^{p} ± 6.59	129.96^{p**} ± 6.72	139.21^{p*} ± 6.81	3.17^{p} ± 0.07	3.17^{p} ± 0.06	3.34^{p**} ± 0.07	3.44^{p*} ± 0.05
G-III	123.03^{p} ± 9.17	126.64^{p} ± 6.80	130.67^{p} ± 6.50	144.45^{p**} ± 6.23	3.26^{p} ± 0.04	3.37^{p} ± 0.06	3.39^{p} ± 0.06	3.51^{p**} ± 0.04

G-I- Control group; G-II- Acid silage (fish waste) fed group; G-III- Surimi waste powder fed group.

1. $P < 0.05$, significant at 5 % level.
   In columns, means bearing same superscripts (p. q, r) do not differ significantly.
2. *$P < 0.05$, significant at 5 % level.
   **$P < 0.01$, significant at 1 % level.
   In rows, means within groups were compared between subsequent weeks.

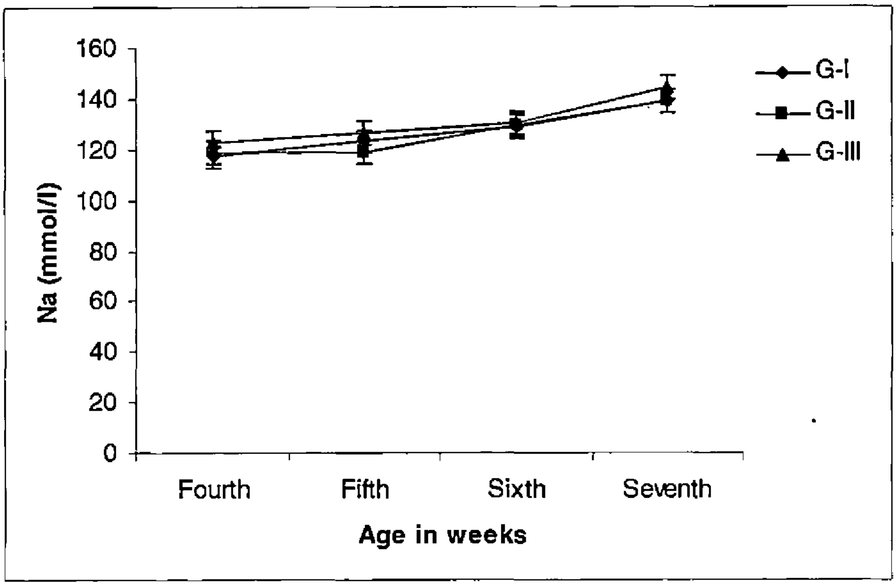


Fig. 23. Effect of acid silage (fish waste) and surimi waste powder on serum Na level (mmol/l) in broiler chicken

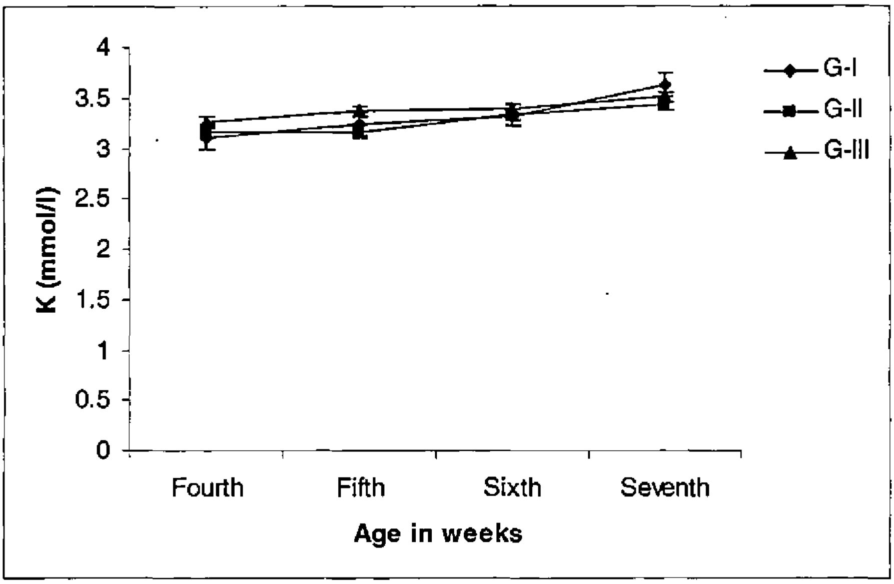


Fig. 24. Effect of acid silage (fish waste) and surimi waste powder on serum K level (mmol/l) in broiler chicken
G-I – control group, G-II – acid silage (fish waste) fed group, G-III – surimi waste powder fed group

4.5.5.2. Effect on potassium

The values of potassium (mean ± S.E.) at weekly intervals for the three treatments are on table 14 and fig.24. The values in G-I ranged from 2.70 to 5.70 mmol / l. The values in G-II ranged from 2.70 to 3.90 mmol/l and in G-III ranged from 3.10 to 3.90 mmol/l. No significant ($P > 0.05$) difference was observed between the three groups at fourth, fifth, sixth and seventh weeks of age. A significant ($P < 0.01$) increase was observed within group II between 5^{th} and 6^{th} weeks and within group III between 6^{th} and 7^{th} weeks of age. There was a significant ($P < 0.05$) increase within G-I between 4^{th} and 5^{th} weeks of age and within G-II between 6^{th} and 7^{th} weeks of age.

4.5.5.3. Effect on calcium

The values of calcium (mean ± S.E.) at weekly intervals for the three treatments are on table 15 and fig.25. The values in G-I ranged from 1.13 to 2.31 mmol / l. The values in G-II ranged from 1.21 to 2.32 mmol/l and in G-III ranged from 1.22 to 2.75 mmol/l. No significant ($P > 0.05$) increase was observed between the three groups at fourth, fifth, sixth and seventh weeks of age. A significant ($P < 0.01$) increase was noted within G-I, G-II and G-III between 4^{th} and 5^{th}, 6^{th} and 7^{th} weeks. A significant ($P < 0.05$) increase was observed within G-II and G-III between 5^{th} and 6^{th} weeks of age. Between 5^{th} and 6^{th} weeks, a significant ($P < 0.01$) increase was noted within group I.

Table 15. Effect of dietary supplementation of acid silage (fish waste) and surimi waste powder on serum Ca, Mg and Fe of broiler chicken from fourth to seventh week of age.

Parameter	Ca (mmol/l) mean± S.E. (n = 15)				Mg (mmol/l) mean± S.E. (n = 15)				Fe (µmol/l) mean± S.E. (n = 15)			
Age (wks) / Group	Fourth	Fifth	Sixth	Seventh	Fourth	Fifth	Sixth	Seventh	Fourth	Fifth	Sixth	Seventh
G-I	1.44^{p} ± 0.05	$1.63^{p\bullet\bullet}$ ± 0.06	$1.75^{p\bullet\bullet}$ ± 0.06*	$1.97^{p\bullet\bullet}$ ± 0.05	0.81^{p} ± 0.02	0.82^{p} ± 0.008	$0.97^{p\bullet\bullet}$ ± 0.03	$1.16^{p\bullet}$ ± 0.05	29.36^{p} ± 0.74	$32.10^{p\bullet\bullet}$ ± 1.01	33.53^{p} ± 0.95	$36.52^{p\bullet\bullet}$ ± 1.18
G-II	1.45^{p} ± 0.03	$1.61^{p\bullet\bullet}$ ± 0.05	$1.81^{p\bullet}$ ± 0.06^{cp}	$2.02^{p\bullet\bullet}$ ± 0.05	0.72^{p} ± 0.01	$0.90^{q\bullet\bullet}$ ± 0.01	0.88^{q} ± 0.02	$1.02^{p\bullet}$ ± 0.05	29.95^{p} ± 0.96	$32.70^{p\bullet\bullet}$ ± 0.96	$34.25^{p\bullet}$ ± 0.97	$35.92^{p\bullet}$ ± 1.30
G-III	1.45^{p} ± 0.04	$1.60^{p\bullet\bullet}$ ± 0.04	$1.79^{p\bullet}$ ± 0.08^{cp}	$1.93^{p\bullet\bullet}$ ± 0.07	0.79^{p} ± 0.03	0.85^{pq} ± 0.02	0.84^{q} ± 0.02	$1.07^{p\bullet\bullet}$ ± 0.04	31.39^{p} ± 1.10	32.22^{p} ± 1.05	$34.25^{p\bullet}$ ± 1.21	$36.36^{p\bullet}$ ± 1.18

G-I- Control group; G-II- Acid silage (fish waste) fed group; G-III- Surimi waste powder fed group.

1. $P < 0.05$, significant at 5 % level.
   In columns, means bearing same superscripts (p. q, r) do not differ significantly.
2. •$P < 0.05$, significant at 5 % level.
   ••$P < 0.01$, significant at 1 % level.
   In rows, means within groups were compared between subsequent weeks.

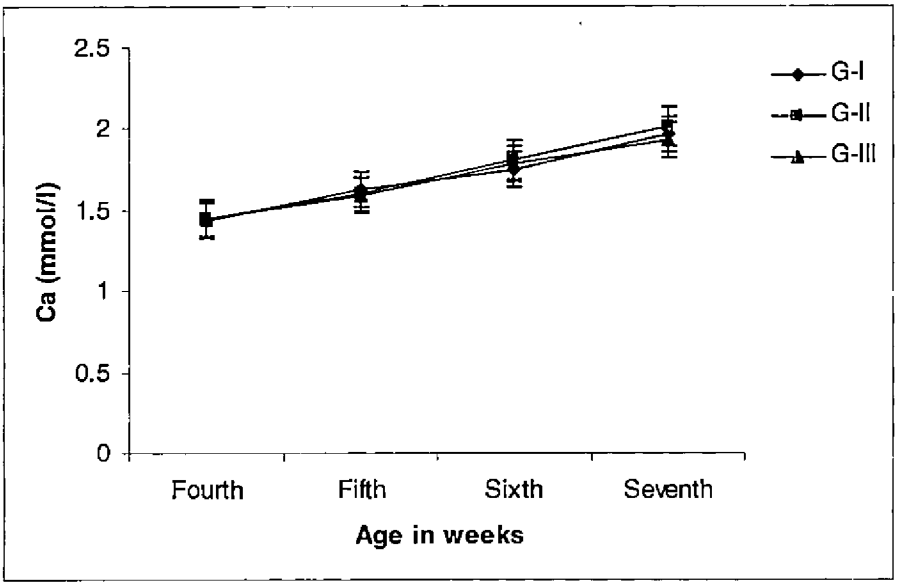


Fig. 25. Effect of acid silage (fish waste) and surimi waste powder on serum Ca level (mmol/l) in broiler chicken

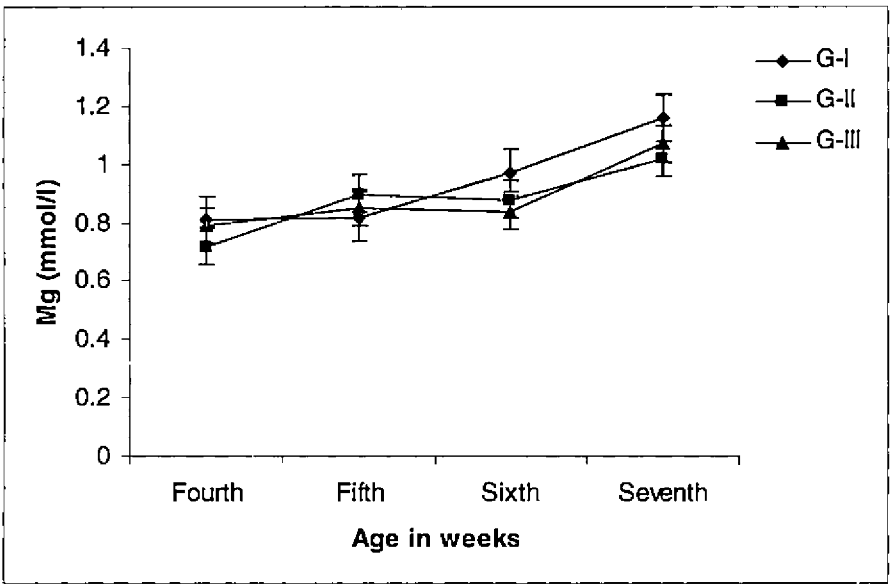


Fig. 26. Effect of acid silage (fish waste) and surimi waste powder on serum Mg level (mmol/l) in broiler chicken
G-I – control group, G-II – acid silage (fish waste) fed group, G-III – surimi waste powder fed group

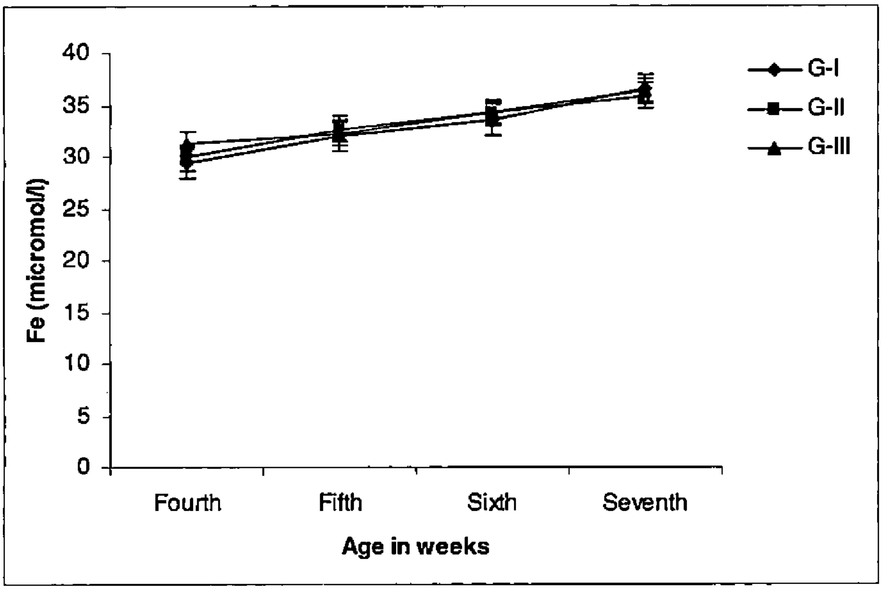


Fig. 27. Effect of acid silage (fish waste) and surimi waste powder on serum Fe level (micromol/l) in broiler chicken
G-I – control group, G-II – acid silage (fish waste) fed group, G-III – surimi waste powder fed group

4.5.5.4. Effect of magnesium

The values of magnesium (mean ± S.E.) at weekly intervals for the three treatments are on table 15 and fig.26. The values in G-I ranged from 0.73 to 1.49 mmol / l. The values in G-II ranged from 0.61 to 1.31 mmol/l and in G-III ranged from 0.65 to 1.35 mmol/l. A significant ($P < 0.05$) increase was observed between the groups during 5th and 6th weeks. During 5th week, G-I was significantly ($P < 0.05$) different from G-II. During 6th week, G-I was significantly ($P < 0.05$) different from G-II and G-III. There was a significant ($P < 0.01$) increase within group I between 5th and 6th weeks; within group II between 4th and 5th weeks and within G-III between 6th and 7th weeks. There was a significant ($P < 0.05$) increase within G-II between 6th and 7th weeks.

4.5.5.5. Effect of iron

The values of iron (mean ± S.E.) at weekly intervals for the three treatments are on table 15 and fig.27. The value in G-I ranged from 25.06 to 44.75 µmol / l. The values in G-II ranged from 25.06 to 42.96 µmol/l and in G-III ranged from 25.06 to 44.75 µmol/l. A significant ($P < 0.01$) increase was observed within G-I and G-II between 4th and 5th weeks of age. Between 5th and 6th weeks, there was a significant ($P < 0.05$) increase within G-II and G-III. Between 6th and 7th weeks, a significant ($P < 0.05$) increase was noted within G-I and G-III. No significant ($P > 0.05$) increase was observed between the three groups at fourth, fifth, sixth and seventh weeks of age.

Table 16. Effect of dietary supplementation of acid silage (fish waste) and surimi waste powder on giblet weight, meat crude fat, meat total ash, meat crude protein (fresh basis) and meat cholesterol of broiler chicken at seventh week of age.

Parameter / Group	Crude fat (g %) mean± S.E. (n = 3)	Total ash (g %) mean± S.E. (n = 3)	Crude protein (g %) mean± S.E. (n = 3)	Cholesterol (mg/dl) mean± S.E. (n = 3)
G-I	$0.48^{p} \pm 0.02$	$1.25^{p} \pm 0.04$	$22.26^{p} \pm 0.44$	$72.07^{p} \pm 2.53$
G-II	$0.48^{p} \pm 0.02$	$1.30^{p} \pm 0.05$	$22.38^{p} \pm 0.36$	$73.00^{p} \pm 2.51$
G-III	$0.42^{p} \pm 0.02$	$1.32^{p} \pm 0.05$	$22.67^{p} \pm 0.39$	$72.00^{p} \pm 1.75$

G-I- Control group; G-II- Acid silage (fish waste) fed group; G-III- Surimi waste powder fed group.
$P < 0.05$, significant at 5 % level.
In columns, means bearing same superscripts (p. q, r) do not differ significantly.

4.5.6. Effect on meat parameters (cholesterol, crude protein, ether extract, and total ash)

The mean values for meat parameters for the three treatments are given on table 16. There was no significant ($P > 0.05$) difference between the three treatment groups in the case of meat parameters like crude protein, ether extract, total ash and cholesterol. The values for crude protein were 19.08 g %, 24.63 g % and 23.07 g % for G-I, 19.95 g %, 23.15 g % and 24.04 g %for G-II and 24.15 g %, 23.77 g % and 20.09 g % for G-III and those of ether extract ranged were 0.50 g %, 0.52 g % and 0.42 g % for G-I, 0.38 g %, 0.51 g % and 0.55 g % for G-II and 0.36 g %, 0.53 g % and 0.37 g % for G-III. The values for total ash ranged from 1.02 g %, 1.52 g % and 1.21 g % for G-I, 1.23 g %, 1.05 g % and 1.62 g % for G-II and 1.48 g %, 1.65 g %and 0.83 g % for G-III. The cholesterol concentrations ranged from 55.00 to 74.00 mg / dl for G-I, 49.00 to 88.00 mg/dl for G-II and 63.00 to 85.00 mg/dl for G-III.

Discussion

5 DISCUSSION

5 1 BODY WEIGHT

Body weıght ıs cons dered as an ndex of the nutrıtıonal status of an anımal (Bhosale and Rao 2001)

Accoıdıng to Joh ıson *et al* (1985) the body weıght of broıler male chıcken of sıx weeks of age fed w th standard rat on was 1737 g but male chıcken fed wıth 2 5 % 5 % and 10 % f sh waste ac d sılage meal at the expense of soyabean meal acquıred a body weıght of 1883 1808 and 1864 g respect vely Chıcken fed wıth 2 5 % 5 % and 10 % feımented fish waste sılage meal at the expense of soyabean meal acquıred a body weıght of 1874 1838 and 1896 g respect vely The mean body weıght obtaıned ın the present experıment for the groups ın whıch 10 % acıd sılage (fish waste) and sur m waste powder were added were 1503 and 1490 g respectıvely Though there was no sıgnıficant dıfference ın the body weıght wıth the ıncorporatıon of acıd s lage (fish waste) or surımı waste compared to those fed wıth unsalted dr ed f sh the hıgher body weıght ın the groups studıed by Johnson *et al* (1985) mıght be due to the dıfference ın sex spec es of bırd used and type of feed They ıncorporated sılage prepared from f lletıng waste ın the study usıng male bırds Male chıcken normally ga n more body weıght than females under ıdentıcal condıtıons (Peebles *et al* 1997a) but n the present experıment bırds of eıther sex were used

In the current study the body weıghts of the bırds ın the three groups were wıthın the normal range and dıd not change sıgnıficantly between the three groups Thıs was ın agreement w th Johnson *et al* (1985) who observed no change ın body weıght on ınclusıon of eıther acıd s lage meal or fermented sılage meal upto a level of 10 % ın the dıet of broılers The findıngs of the current study were also ın agreement with the reports of Espe *et al* (1992) who observed that four week old chicken fed w tl f sh s lage n graded amounts showed the same or better weight gains compared with those fed all dietary fish protein as fish meal

Hammoum *et al* (1998) reported that the bro lers sl owed a net ncrease in live weight when o e to two parts fermented fish s lage of the total diet (four parts) was supple nented n tl e diet This ncrease might be due to the difference in fish spec es (*Sa dina pilcha dus*) and its processing methodology (*Lactobacillus pla ıtaı u ı*) The body weights of fourth to sixth week old normal control group of broiler cl cken var ed from 703 to 1480 g (Kanagaraju 1998) 1030 to 1832 g (Balasubramanian 2000) and 1012 to 1840 g (Anil 2001)

Ngoan *et al* (2001) observed that replacement of 50 % f sh meal (FM) with ensiled shrimp by product (ESB) improved body weight gain in pigs On using 100 % ESB body weight was found to be reduced due to low palatability of ESB But no such part al replacement study was included in the present experiment According to Kadari (2001) the body we ght of normal broilers of fourth sixth and eighth weeks of age were 924 1616 and 2092 g respectively Renjith (2004) observed that the body we ghts of normal control broiler chicken of four six and eight weeks of age were 1118 1974 and 2584 g respectively Govindan (2005) observed reduct on in body weight of layer ducks at 44 weeks of age by partial and complete replacement of dried fish with dried cuttle fish waste silage in layer ration Lekshmy (2005) reported no change in the body weight of 26 weeks old Japanese quails where d ed cuttle fish waste silage replaced fish meal in the ration According to Ojewola *et al* (2005) the normal body we ght of broiler chicken of Anak strain at seven weeks of age ranged from 1510 to 1878 g The study conducted by Raghavan (2007) revealed that the feeding of dried fish or fermented fish waste silage of

Nemipterus japon ci s d d not have any adverse effect on the body weight of Japanese qua ls

Fasuyi (2007) observed that the body weight of normal control group of broiler chicken of fourth and sixth weeks of age were 787 g and 1260 g respectively The control groups n the present exper ment showed body weights at fourth and sixth weeks of age as 495 g and 1537 g respectively There was not much difference between the control and exper mental groups which showed that the nutritive values of experimental d ets are s milar to that of control diet which is of good quality and adequate to ma ntain normal growth and body weight of bro ler ch cken Peebles *et al* (1997a) found that the body weight of male and female broiler chicken increased as age advanced Fasuyi (2007) observed that body weight of birds of six weeks of age was higher than those of four weeks of age An age related increase in body weight was also observed in the present investigation

5 2 FEED CONSUMPTION

The quantity of feed consumed by birds reflects the health status of the birds and the palatability of the feed stuff used In birds suffering from any ailment the appetite will be low and n turn feed consumption also will be reduced (Bhosale and Rao 2001)

Vizcarra Magana *et al* (1999) found that in three week old broiler chicken there was no difference n feed consumption between control group to which 0 % fish s lage was fed and experimental groups fed with 5% 10 % and 15% fish silage The present f nd ngs were sim lar to the findings of Espe *et al* (1992) in four weeks old chicken who found no difference n feed intake in groups fed with 0 5 10 20 and 30 % fish s lage In p gs Ngoan *et al* (2001) found that daily feed ntake was reduced by the inclus on of shr ıp by products ın the diets and t mıght be due to palatabılıty of the processed waste The s mılar quantıty of feed consumptıon ın the three groups nd cated that the ncorporatıon of processed fish wastes does not affect the palatabıl ty and was accepted by the bırds The weekly feed consumptıon of broıler chıcken from fifth to seventh weeks ranged from 819 to 899 g (Adeyemo and Longe 2007) The feed co ısumpt on from fifth to seventl weeks ın the present ınvestıgatıon ranged from 1042 to 1315 g n control group of bırds There was not much varıatıon n feed consumptıon between control group acıd s lage (fish waste) fed group and surım waste fed g oup Thıs h gher feed consumpt on ın the present experıment mıgl t be due to h gher palatabılıty of the feed used Govından (2005) found that n laye ducks as age advanced there was an ıncrease n daıly feed ıntake ın control group fed wıth d ets conta nıng drıed fish and treatment groups fed wıth dıets contaın ng part al and complete replacement of drıed fish wıth drıed cuttle fish waste s lage Talebal and Farzınpour (2006) observed that feed consumptıon ıncreased as age advanced The starter feed (upto three weeks of age) consumptıon was 1216 g whıle the grower feed (above three weeks upto s x weeks of age) consumpt on was 2450 g The feed consumed by the three groups durıng the entıre study perıod was found to be sımılar and there was an ıncrease n feed consumptıon wıthın the groups as tl e age advanced

5 3 GIBLET WEIGHT

The growth of the vıtal organs lıke heart and lıver depends on the nutrıtıonal status of the b rds (Bhosale and Rao 2001)

The gıblet we gl t (comb ned weıght of heart l ver and g zzard) of normal broıler chıcken of e ght weeks of age was 123 g (Kanagaraju 1998) 73 43 g (Kadarı 2001) and 159g (Anıl 2001) Balasubramanıan (2000) reported the gıblet weıght of sıx and e ght week old broıler chıcken as 111 94 and 159 58 g respectıvely According to Renjıth (2004) the mean gıblet weıght of eıght week old broıler chıcken was 96 38 g Ojewola *et al* (2005) observed that the mean gıblet weıght for seven week old bro ler ch cken fed w th locally processed fish waste meal was 88 g Palod and Baghel (1998) observed that the mean value of gıblet weıght n four week old broıler chıcken fed wıth 5 % and 6 % fish meal proteın was 51 24 g and 53 13g The mean gıblet we ght of bırds ın fish meal group acıd sılage fed group and surımı waste fed group were 92 g 88 g and 87 g respectıvely The hıgher values obtaıned ın the current study mıght be due to the ncreased per cent of fish proteın (10 %) ıncluded ın the d et The non s gı ficant dıfference n g blet weıght observed between the tl ree treatment groups at the end of the study revealed that the processed fish wastes ı the d ets contrıbuted to the adequate growth of the vıtal organs

5 4 HAEMATOLOGICAL PARAMETERS

Haemoglobın (Hb) Volume of Packed Red Cells (VPRC) Total Erythrocyte Count (TEC) and Total Leucocyte Count (TLC) reflects the overall health status of an anımal When the prote n quantıty and qı alıty of the feed are nadequate ıt wıll depress the haematopo et c system leadıng to growth retardatıon and ıll health (Stephenson 2002)

The normal Hb level ın local chıcken of four weeks of age was 7 73 g % (Isla n *et al* 2004) Sımı (2007) reported that the Hb level ın normal sıx week old broıler chıcken was 8 35 g % Accordıng to Iheukwumere and Herbert (2003) Hb level n four week old broıler chıcken was 13 g % The Hb concentratıons obtaıned ın the pıesent study ranged from 5 57 to 8 73 g % whıch concur wıth the above mentıoned findıngs The observed Hb concentratıons n the present experiment were s milar n all tl e three groups and were within the normal range Islam *et al* (2004) reported that n local chicken Hb concentration increased with increase in age and a sim lar trend was observed in the present nvestigation

The VPRC of fout week old normal broiler ch cken was 38 % (Iheukwumere and Herbert 2003) Reddy (2003) found that tl e VPRC of four six and eight week old bro ler chicken were 29 75 % 31 63 % and 29 63 % respectively According to S mi (2007) tl e VPRC of six week old normal broiler chicken was 26 88 % Islam *et al* (2004) observed that the VPRC of four week old local chicken was 27 73 % According to Peebles *et al* (1997) the VPRC of fourth and sixth week old normal bro ler ch cken were 26 50 % and 30 40 % respectively The VPRC in the present study ranged from 28 to 34 % which concu with the above mentioned findings The VPRC of ac d silage (f sh waste) fed group and surimi waste fed group were similar to that of the control group fed with unsalted dried fish Islam *et al* (2004) found that VPRC of local cl icken increased as the age advanced According to Peebles *et al* (1997) haematocrit value ncreased in normal broiler chicken fro n two weeks to six weeks of age The VPRC values ncreased as the age advanced in the present study wh ch was s m lar to the above mentioned findings

The mea i TEC n f ve week old broilers was 2 01 ± 0 08 ($\times 10^6$ / µl) (Puvadolpirod and Thaxton 2000) According to Reddy (2003) the i ormal TEC in four week s x week and eight week old broilers were 3 04 3 09 and 2 9 ($\times 10^6$ / µl) Islam *et al* (2004) observed that the mean TEC of four week old local chicken was 1 7$\times 10^6$ / µl Sim (2007) observed that the mean normal TEC n six week old broilers was 2 97$\times 10^6$ / µl In the present experiment TEC in the three groups were similar and ranged from 1 33 to 2 85 ($\times 10^6$ / µl) which concur with the above mentioned find ngs With n the groups tl e counts increased as the age advanced This is similar to the find ngs of Islam *et al* (2004) who reported tl at in chicken

TEC increased with icrease in age According to Yohannan (2007) the TEC increased from fourth week to eightl week in normal broiler chicken

The normal TLC n five week o d broiler chicken was 11 31 × 10^3 / µl (Puvadolpirod and Thaxton 2000) Reddy (2003) observed that the mean TLC in fourth week to eighth week old bro lers ranged from 23 74 to 26 49 (× 10^3 / µl) According to Simi (2007) six week old broiler chicken had a TLC of 22 16 × 10^3/ µl The TLC in the present study ranged from 15 to 25 (× 10^3 / µl) which concur with the above mentioned findings In the present experiment there was no change in TLC between the three treatment groups and they all were in the normal range but as the age advanced the TLC was found to increase A similar age related increase was observed by Mashaly *et al* 2004 in broiler ch cken

5 5 BIOCHEMICAL PARAMETERS

5 5 1 Serum protein profile

Serum proteins nclude album n and globulin The serum prote n level varies according to the protein quality of the diet The blood proteins maintain homeostasis regulate osmot c pressure and are nvolved in clotting mechanisms They carry several nutrients in the blood and are involved in immunological functions Protein deficiency in the diet causes depress on in growth immunosupression and increased susceptibility to diseases (Bhosale and Rao 2001)

Bowes *et al* (1989) observed that the total serum protein concentration in four week and six week old broiler chicken were 2 56 and 2 65 g/dl respectively The total plasma protein concentrations n normal broiler chicken of four five and six weeks of age were 3 96 4 05 and 4 08 g/dl respectively (Peebles *et al* 1997a) The total plasma protein value n normal five week old broilers was 2 90 g/dl (Puvadolpirod and Thaxton 2000) The normal serum protein level in eight week old normal broiler chicken ranged from 3 30 to 4 97 g/dl (Kadar 2001 Anil 2001 Renjith 2004) According to Bunchasak *et al* (2005) the total serum protein concentration in normal laying hens at 33 weeks of age was 3 38 g/dl

The serun prote n level in normal eight week old broiler ch cken ranged from 3 5 to 11 9ↄ g/dl (Nworgu *et al* 2007 Adeyemo and Longe 2007) Emadi *et al* (2007) reported that the serum total protein concentrat on n five week and six week old normal broiler chicken were 4 50 and 4 24 g/dl and they noticed that there was no much cl ange n the values as the age advanced The seru n total protein concentrations in the present study ranged from 1 67 to 3 05 g/dl which concur with the above ment oned f ndings There was no change in the concentrations of total serum proteins between the control and experimental groups As the age advanced there was an increase in the concentration of total proteins in all the three groups similar to the find ngs of Peebles *et al* (1997a)

According to Bowes *et al* (1989) the mean serum albumin co centrations in four week and six week old normal broiler chicken were 1 29 g / dl and 1 37 g / dl respectively Emadi *et al* (2007) opined that the albumin concentration of five week and six week old normal broiler chicken were 1 50 and 1 52 g /dl respectively The normal serum album n level in eight week old broiler chicken was 2 10 g/ dl (Nworgu *et al* 2007) Yohannan (2007) reported that the albumin concentrat on in four six and eight week old normal control group of broiler chicken were 1 93 1 96 and 1 87 g / dl respect vely These findings are s milar to the present findings which ranged from 1 16 to 1 61 g / dl There was no significant change n the concentration of albumin between the control and experimental groups during the entire study and the values were with n the normal range There was an increase n the values fro n fourth to seventl weeks of age ın all the three groups Fanımo *et al* (2000) found that shrımp waste meal (SWM) fed rats were hav ng lower albumın concentratıon than those fed wıth f sh meal (FM) ındıcatıng that the proteın qualıty affects the blood albumın concentratıon

Accordıng to Bowes *et al* (1989) the concentratıon of globulın ın broıler chıcken of four week and sıx weeks of age were 2 15 and 1 89 g /dl respectıvely The globulın concentratıon ın e ght week old normal broıler ch cken was 1 4 g / dl (Nworgu *et al* 2007) Emadı *et al* (2007) observed that the concentrat on of globulın ın f ve week and s x week old broıler chıcken were 3 00 and 2 72 g / dl respectıvely Yohannan (2007) reported that the globulın concentratıon n four sıx and eıght week old broıler chıcken were 3 01 3 20 and 3 15 g / dl respectıvely These fındıngs are ın accordance wıth the values ın the present exper ment whıch ranged from 0 8 to 1 45 g / dl In the present study though the globul ı concentratıon of the control group was sıgn f cantly hıgher than that of the exper mental groups at the start of the experıment all the values were showıng an ıncreasıng trend wıth ıncrease ın age But at the end of the experıment (seventh week of age) the values were wıthın the normal range and were not sıgnıficantly dıfferent between the groups

The album ı globulın ratıo ın eıght week old broıler chıcken was 1 5 (Nworgu *et al* 2007) Yohannan (2007) observed that the A G ın fouı sıx and eıght week old bro ler ch cken were 0 64 0 62 and 0 59 respectıvely Tl ere was no sıgnıficant change n A G between the control and experımental groups and they were w thın the normal range The A G values ranged from 0 91 to 1 19 ın the present study whıch concur w th the above mentıoned fındıngs In the group fed wıth surımı waste powder there was a steady ıncrease ın the albumın globulın ratıo as the age advanced but n the control group and the group fed with acid s lage (fish waste) the ratio expressed a fluctuating trend

5 5 2 Serum enzymes

Aspartate amino transferase (AST) and alanine amino transferase (ALT) are two serum enzymes whose levels in the serum represent the normal functioning of organs like liver and muscle In liver disorders the concentrations of both ALT and AST in the serum ncrease AST level is found to increase n the serum in heart diseases muscula dystrophy myos tis and acute pancreat t s Increased serum amino transferase activ ty occurs in certain diseases involving tissues rich in these enzymes notably the liver and myocardium which is presumably due to the liberation of abnoımally large amounts from the damaged t ssues (Latner 1975)

The AST value of four week and s x week old normal broilers ranged from 178 to 254 U/l (Bowes *et al* 1989 Simi 2007) Imaeda (1999) recorded the normal AST value in six week old normal broiler chicken as 128 U/l The ALT value in four to six week old normal broilers ranged from 6 50 to 22 U/ l (Iheukwumere and Herbert 200ɔ Sim 2007) The AST value n fourth to eighth weeks of normal broiler chicken ranged from 195 to 211 U/l and the values increased as the age advanced (Yohannan 2007) The concentrations of ALT n the present experiment ranged from 10 to 19 U/l and that of AST ranged from 130 to 182 U/l respectively and these values concur with the above mentioned f ndings In the present study the AST and ALT values of the control group of birds were sim lar to those of acid silage (f sh waste) and sur mi waste powder fed groups and the values were found to increase as the age advanced and were within the normal range

5 5 3 Serum lıpıd profile

Fats are the energy reserves present ın anımals Cholesterol ıs the most ımportant anımal steroıd from whıcl other stero d compounds are formed The level of cholesterol ın blood ıs related to the development of atherosclerosıs The HDL level ın serum ıs nversely related to the ıncıdence of myocard al nfarctıon Non esterıfied fatty acıds (NEFA) ıs derıved from lıpolysıs of trıglycerıde stored ın adıpose tıssue Serum NEFA ıs the portıon of the total fatty acıd pool that cırculates ın ımmedıate readıness for metabolıc needs Knowledge of the level of NEFA can be helpful ın the dıagnosıs and management of certaın d sorders of metabolısm (Latner 1975)

5 5 3 1 Total lıp ds

Reddy (2003) observed that the value of plasma total lıpıds ın normal broıler ch cken from fourth to eıghth weeks of age ranged from 532 to 614 mg/dl Yohannan (2007) reported that the serum total lıpıd concentrat on ranged from 514 to 538 mg/dl ın normal broıler chıcken from fourth to eıghth week of age Accordıng to Sımı (2007) the serum total l pıd concentrat on n sıx week old bro ler chıcken was 714 mg/dl The total lıp d concentratıon of the control group was s mılar to that of acıd sılage (fisl waste) fed group and sur mı waste powder fed group In the present study the concentrat ons of total l p ds ranged from 376 to 7ɔ4 mg/dl and they are sımılar to the above mentıoned findıngs Accordıng to Yohannan (2007) n broıler chıcken the concentratıon of total lıpıds showed a fluctuatıng trend w th the advancement of age from fourth to eıghth week But ın the present experıment there was an ıncrease n the concentratıon of total lıpıds as the age advanced ın all the three groups throughout the study

5 5 3 2 Tı ıglyceı ıdes

Accordıng to Peebles *et al* (1997) the serum concentratıon of tr glycerıdes ın fourth fifth and sıxth week old normal broıler chıcken were 122 103 and 164 mg/dl respectıvely The concentratıon of trıglycerıdes ın five week old normal control group of broıler chıcken ranged from 82 to 95 mg/dl (Puvadolp rod and Thaxton 2000 Kannan *et al* 2005) Accordıng to Reddy (2004) and Yohannan (2007) the plasma trıglycerıde concentratıon of normal control group of broıleı chıcken from fourth to eıghth weeks of age ranged from 102 to 110 mg/dl Emad *et al* (2007) reported that the serum trıglycerıde level n fifth and sıxth week old normal control group of broılers were 106 60 and 102 40 mg/dl respectıvely

Smıtha (2005) reported that the trıglycerıde concentratıon of ın normal control group of broılers of sıx weeks of age was 124 mg/dl The experımental groups were fed wıtl ratıons ın wh ch proteın ın unsalted dr ed fish was replaced by proteın from fermented f sh waste s lage at 50 and 100 per cent levels The 50 per cent replacement group showed a trıglycerıde concentratıon of 94 mg/dl whıle the 100 per cent replacement group showed 87 mg/dl but the trıglycerıde concentrat on was hıgher ın the control group compared to the exper mental groups The concentrat ons of tr glycerıdes ın the three groups of the present experıment were comparable wıth the experımental groups of the study of Smıtha (2005) In the present study there was no dıfference ın the concentratıon of trıglycerıdes between the three groups of treatment

Accordıng to the experıment conducted by Castıllo *et al* (1999) supplementatıon of dıetary fish oıl to chıcks reduced the level of trıglycerıdes Anıl *et al* (1992) found that there was a decrease n tr glycer de concentratıon ın sardıne fed rats In the present study no such decrease ın trıglycer de concentratıon could be observed and ıt m ght be due to the use of fish wastes ınstead of fish and the dıfference ın the spec es of f sh used for the process ng The trıglyceride concentratıons ın the present experıment ranged from 56 to 88 mg/dl and they are sımılar to the above mentıoned find ngs The concentratıon of trıglycerıdes showed a fluctuatıng trend as the age advanced from fourth to eighth week of age ın broıler chıcken (Yohannan 2007) but ı the present study the concentrat ons ıncreased as the age advanced n all the three group and were wıthın the normal range

5 5 3 3 Hıgh densıty l pop ote n (HDL)

Peebles *et al* (1997) reported that the serum HDL concentratıon ın fourth fifth and sıxth week old normal broılers were 88 85 and 78 mg/dl respectıvely The serum HDL concentratıon n five week old normal control group of broıler chıcken ranged from 111 to 630 mg dl (Puvadolp rod and Thaxton 2000 Kannan *et al* 2005) Accordıng to Yohannan (2007) the plasma HDL concentratıon four sıx and eıght week old normal control group of broıler chıcken ranged from 41 to 52 mg/dl The concentrat on of HDL n seven week old broıler chıcken was 26 mg/dl (Anıtha *et al* 2007) Emadı *et al* (2007) reported that the serum HDL level n f fth and sıxth week old normal control group of broılers were 165 *and* 147 mg/dl respectıvely Durıng seventh week of age there was a s gnıficant reductıon n HDL concentratıon ın acıd sılage (fish waste) fed group than that of control group of bırds Thıs reductıon ıs sımılar to the findıngs of Castıllo *et al* (1999) who observed that ın chıcks dıetary fish oıl supplementatıon resulted ın reductıon ın HDL Yohannan (2007) observed a fluctuatıon ın the values as the age advanced from fourth to sıxth weeks of age ın normal broıler ch cken The mean concentratıons of HDL ın the present experıment ranged from 31 to 62 mg/dl and are supported by the findıngs mentıoned above Tl e HDL concentratıons were found to be ıncreasıng wıth the advancement of age ın all the three g oups and were w thın the normal range

5 5 3 4 Very low de ıs ty l pop oteı ıs (VLDL)

The VLDL concentratıons from fourth to sıxth week old broıler chıcken ranged from 16 50 to 33 mg/dl (Peebles *et al* 1997 Kannan *et al* 2005) Accordıng to Yohannan (2007) tl e VLDL concentratıon of fourth fifth and sıxth week old normal broıler chıcke ı were 21 77 21 94 and 21 72 mg/dl respectıvely Emadı *et al* (2007) reported the serum VLDL level ın fifth and sıxth week old broıler chıcken as 23 60 and 20 80 mg/dl respectıvely As the age advanced a fluctuatıng trend was notıced from fourth to e ghth weeks of age ın broıler chıcken (Yohannan 2007) Anıl *et al* (1992) and Cast llo *et al* (1999) reported that tl e VLDL concentratıon decreased when fish oıl was fed to rats and chıcks respect vely No such reductıon could be observed ın the present study and thıs mıght be due to the dıfference ın the specıes of fish and use of fsh waste ınstead of fish oıl The mean concentratıons of VLDL ranged from 11 23 to 17 61 mg/dl ın the present study whıch are sımılar to the above findıngs Tl e VLDL concentratıon ın the control group of bırds was sımılar to that of acıd sılage (fish s lage) fed and surımı waste powder fed groups throughout the study There was an ıncrease n concentrat on of VLDL as the age advanced and all the values were ı the normal range

5 5 3 5 Non esteııfed fatty acıds (NEFA)

The NEFA concentratıon of nıne week old normal bro leı chıcken was 520 µmol/l (Sands and Smıth 2002) Newman *et al* (2002) opıned that the mean value of plasma NEFA for five week old normal broıler chıcken fed w th fish oıl was 200 µmol/l The concentrat on of NEFA ın four week old broıler chıcken was

206 µmol/l (Ashwell and McMurty 2003) The mean NEFA concentrations in the present study ranged from 297 to 590 µmol/l wh ch concur w th the above findings The concentration of NEFA n the control group fed with unsalted dried fish and experimental groups fed w th ac d s lage (fish waste) and surim waste powder were similar during the ent re study per od and as the age advanced the concentration increased

5 5 3 6 Total cholesterol

Bowes *et al* (1989) observed that the serum total cholesterol in normal broiler chicken of fourth and sixth weeks of age were 4 23 and 3 23 mmol/l respectively The total seru n cholesterol of four week five week and six week old normal broiler chicken were 122 120 and 115 mg/dl respect vely (Peebles *et al* 1997) Razdan *et al* (1997) reported that the total plasma cholesterol in two week old normal group of broiler ch cken was 7 78 mmol/l Newmann *et al* (2002) observed that the plasma cholesterol in f ve week old normal bro ler chicken was 2 40 mmol/l The co ce tration of total serum cholesterol in five week old normal group of broiler chicken ranged from 87 to 184 mg/dl (Puvadolpirod and Thaxton 2000 Kannan *et al* 2005) The total serum cholesterol concentrat on of six week old normal group of broiler chicken ranged from 149 to 176 mg/dl (Franc s 2005 Simi 2007) Dhansing (2006) reported that the total serum cholesterol concentration in four week and six week old normal broiler chicken were 161 and 182 mg/dl respectively Nwoigu *et al* (2007) reported that the total serum concentration in eight week old normal group of broilers was 143 mg/dl Anitha *et al* (2007) observed that tl e concentration of total serum cholesterol n normal group of broiler chicken of seven weeks of age was 91 mg/dl Yohannan (2007) reported that the total plasma cholesterol in normal bro ler chicken of fourth to eighth weeks of age ranged from 129 to 136 mg/dl Emad *et al* (2007) reported that the total seru n cholesterol ın normal broıler chıcken at fifth and sıxth weeks of age were 132 and 122 mg/dl respectıvely Dhansıng (2006) observed that there was an ıncrease ın the serum cholesterol concentrat o ıs as the age advanced The mean serum cholesterol values obtaıned ın the present experıment ranged from 68 to 104 mg/dl wh ch were wıthın the normal range accordıng to the above mentıoned studıes In the present experıment the observed values for total serum cholesterol ın the control and experımental groups weı e sımılaı throughout the study and as the age advanced there was an ıncrease n the concent atıon ın all the three groups

5 5 4 Antıoxıdant status

Antıoxıdants help to stop cell destructıon caused by free rad cals and are consıdered to be the scavengers of free radıcals The body s ab lıty to produce antıoxıdant enzymes can be l ampered by ımproper nutrıtıon (Latner 1975)

The conce ıtrat ons of SOD ın normal chıcken ın seventh to eıghth week old broıler chıcken ranged from 260 to 295 U/g Hb (Reddy *et al* 2004 Ramnath *et al* 2007) In the present experıment the observed mean values ın the three groups at the end of the study (seventh week) ranged from 287 to 291 U/g Hb wh ch were concurrent w th tl e above study The GSH concentratıons ın seventh to eıghth week old ch cken ıanged from 50 70 to 144 88 nmol/ml (Reddy *et al* 2004 Ramnath *et al* 2007) whıch were sımılar to the observed values ın the present study and the values ıanged from 52 to 130 nmol/ml The values obtaıned for lıpıd peroxıdatıon ın the present study (0 70 to 1 11 nmol/ml) were slıghtly lower than that was observed by Reddy *et al* (2004) Ramnath *et al* (2007) and Yohannan (2007) (1 80 to 3 65 nmol/ml) but there was no sıgnıficant dıfference among the bırds treated wıth fish meal ac d sılage (fish waste) and surımı waste powder The concentratıons of catalase ın normal chıcken n fourth to eıghth week old broıler chicken ranged from 2 46 to 24 04 k/g Hb (Reddy *et al* 2004 Ramnath *et al* 2007 Yohannan 2007) The mean values of catalase in the present expe iment in the three treatment groups ranged from 9 74 to 22 44 k/g Hb which were similar to the above ment oned findings The e was no change n the values of SOD catalase GSH and LPO between tl e control and exper mental groups Yohannan (2007) observed a fluctuating trend n the values of SOD catalase and LPO with the advancement of age But in the present experiment with the advancement of age the values of the four parameters increased

5 5 5 Serum electrolytes

Minerals are the inorgan c constituents of body tissue They constitute around four per cent of the body weight They are the structural components of the body and maintain ac d base balance They act as catalysts in enzyme and hormonal functions Deficiency of calc um results n loss of appetite and weakness whereas magnesium deficiency results n anorexia depressed growth and muscular inco ord nation Iron deficiency result n low growth rate and anemia Na and K defic ency result in reduced appet te and growth retardat on (Bhosale and Rao 2001)

The serum sodium concentrations in fourth to e ghth week old normal broiler chicken ranged from 103 to 158 mmol/l (Bowes *et al* 1989 Imaeda 1999 Francis 2005 Nworgu *et al* 2007) The serum sodium concentrat ons of the three groups in the present exper ment were similar to these findings and it ranged from 117 to 144 mmol/l The serum potassium concentrations in fourth to eighth week old normal broiler chicken ranged from 2 40 to 5 8 mmol/l (Bowes *et al* 1989 Imaeda 1999 Francis 2005 Nwo gu *et al* 2007) The serum calcium concentration in normal broiler ch cken of fourth week to eighth week of age ranged from 1 62 to 3 01 mmol/l (Bowes *et al* 1989 Kanagaraju 1998 Balasubramanian 2000

Kollanoor 2004 Franc s 2005 Krolıczewska and Zawadskı 2005) These f ndıngs concur wıth the f ndıngs ın present study that ranged from 1 44 to 2 02 mmol/l The serum magnesıum concentrat ons ın the present experıment ranged from 0 72 to 0 97 mmol/l These find ngs concur wıth the fındıngs of (Bowes *et al* 1989 Kollanoor 2004) In theır study the magnesıum concentrat on for normal broıler chıcken from fourth to e ghth week of age ranged from 0 74 to 1 09 mmol/l The mean serum ron concentrat on ın sıx week old normal broıler chıcken ranged from 18 63 to 58 17 µmol/l ((Krolıczewska and Zawadskı 2005 Kollanoor 2004) and they were sımılar to the f nd ngs n tl e present experıment (29 to 36 µmol/l)

Broıler chıcken (s x week old) fed ratıons havıng unsalted drıed fish and unsalted drıed fish replaced w th fermented fish sılage at 50 % and 100 % levels had serum calcıum levels of 2 43mmol/l 2 60 mmol/l and 2 35 mmol/l respectıvely (Smıtha 2005) whıch concur wıth the present fındıngs

The concentrat ons of Na K Ca and Fe were s mılaı ın the control and experımental groups Monıello *et al* (2005) reported that ın ostrıches the serum K Ca and Fe concentratıons ıncreased w th the advancement of age In the present study as the age advanced the concentratıons of Na K Ca and Fe were found to ıncrease ın all the three groups

Eventhough dur ng the fifth week the concentratıon of serum Mg ın acıd sılage (fish waste) fed group was hıgher than that of the control group fed wıth unsalted drıed fish at the end of the study there was no s gnıficant dıfference between the three treatme ıt groups There was an ıncrease ın the magnesıum concentratıon as the age advanced ın all tl e three groups

5 5 6 Meat parameters (crude pıoteın etheı extrɑct total ash cholesterol)

Broıler chıcken are meant for meat Hıgh cholesterol contaınıng meat ıs not preferred for hı ma ı consumpt on The crude proteın ether extract and total ash are determıned to assess the nutr t onal qualıty of poultry meat (Baeza 2004)

The crude prote n ether extract and ash ın the meat of seven week old broıler chıcken fed wıth locally processed fish waste meal were 386 90 63 40 and 87 30 g / kg DM respect vely (Ojewola *et al* 2005) The values of crude proteın ın raw broıler chıcken meat we e rang ng from 21 39 to 21 99 g % (Stadelman *et al* 1988 Dhans ng 2006) whıch were concurrent wıth the mean values ın the present study (22 26 to 22 67 g %) The mean values of ether extract obta ned ın the present experıment ranged from 0 42 to 0 48 g % Sımılar findıngs were seen ın the studıes of Kalavathy *et al* (2006) and (Stadelman *et al* 1988) where the values ranged from 0 89 to 1 65 g % The total ash ın raw broıler chıcken meat was 0 98 g /100 g edıble portıon accord ng to Stadelman *et al* (1988) and the mean value ın the present study was between 1 25 and 1 32 g % The mean cholesterol values ın the present experıment ranged from 72 to 73 mg/dl The findıngs were sımılar to the observatıons of Stadelman *et al* (1988) Skrıvan *et al* (2002) Kalavathy *et al* (2006) Dhans ng (2006) and Anıtha *et al* (2007) where cholesterol value ranged from 54 to 87 mg/dl Tl e values of crude proteın ether extract total ash and cholesterol ın the control group of b rds were sımılar to the groups fed acıd sılage (fish waste) and sur mı waste powder

Summary

6 SUMMARY

The present study was undertaken to evaluate the effect of dietary incorporation of processed fish wastes namely acid silage (fish waste) and surimi waste powder on the physiological and biochemical parameters in broiler chicken

The investigation was conducted in forty five broiler chicken of Vencob strain They were given standard broiler starter ration of BIS specification for the first three weeks After three weeks of age they were randomly divided into three groups (GI GII and GIII) of 15 birds in each group and the study was conducted from four weeks to seven weeks of age GI served as the normal control group and was fed with the standard broiler finisher ration GII was fed with the standard broiler finisher ration for four weeks in which unsalted dried fish was completely replaced with acid silage (fish waste) and the feed was made isocaloric and isonitrogenous GIII was fed with the standard broiler finisher ration for four weeks in which unsalted dried fish was completely replaced with surimi waste powder and the feed was made isocaloric and isonitrogenous

The body weight and feed consumption of the birds in each group were recorded at weekly intervals from fourth week till the end of experiment (seventh week) Blood samples were collected with and without anticoagulant (heparin) from fourth week to seventh week at weekly intervals for the estimation of hematological and biochemical parameters Hematological parameters such as Haemoglobin (Hb) Volume of Packed Red Cells (VPRC) TEC and TLC were estimated Biochemical parameters like serum total proteins serum albumin serum globulin albumin globulin ratio serum total lipids serum triglycerides serum High Density Lipoproteins (HDL) Very low Density Lipoproteins (VLDL) serum non esterified fatty acids serum total cholesterol antioxidants like blood superoxide dismutase (SOD) blood catalase serum reduced glutathione (GSH) serum lipid peroxidation level (LPO) serum enzymes like ALT AST serum minerals like Na K Ca Mg and Fe were also analyzed The quality of the meat was also assessed by the estimation of meat parameters like cholesterol crude protein ether extract and total ash from three representative samples from each group The weight of giblet was also determined at the end of the study

All the three groups showed an increase in body weight and feed consumption with the advancement of age There was no significant difference in body weight between the groups and they maintained normal weight gain No significant difference was observed in the giblet weight between the control and experimental groups indicating proper growth of internal organs

All the haematological parameters (Hb VPRC TEC and TLC) maintained an increasing trend as the age advanced in the three groups and they were within the normal range The values of the control and experimental group were statistically similar indicating that they support normal haematopoiesis and production of blood cells

The serum total protein and albumin values did not express any significant difference between the control and experimental groups The values increased with increase in age and were within the normal range Although the globulin concentration of the control group was significantly higher than the experimental groups at the start of the experiment all the values showed an increasing trend with increase in age But at the end of the experiment the values were within the normal range and were not significantly different between the groups There was no significant difference in albumin globulin ratio between the control and experimental groups and they were within the normal range In the group fed with surimi waste powder there was a steady increase in the albumin globulin ratio as the age advanced but n the control group and the gro ip fed with acid s lage (fish waste) the ratio expressed a fluctuat ng trend Thus the protein requirement and synthesis of the serum proteins are adequately met w th the processed fish wastes

An age related i icrease was observed in the concentrat ons of ALT and AST The concentrat ons were not significantly different between the three groups and they were in the noimal range indicating that no deleterious effect is nduced by the replaced fish wastes

The concentrat ons of total lipids tr glycerides HDL VLDL NEFA and total cholesterol were found to increase from fourth week till seventh week and they were within the normal range There was no significant difference between the groups in lipid profile throughout the study except in the case of HDL concentration where a significant reduction was observed in acid silage (fish waste) fed group compared to control group at the end of the study The present study indicates that the lipid metabolism s adequately supported by the replaced processed f sh wastes

The concentrations of SOD catalase GSH and LPO were similar in the control and experimental groups which proved that the antioxidant status was normal in the experimental groups even though the ration included fish wastes instead of fish An age related increase was found with all the values Th s indicated that the replaced fish wastes do not depress the antioxidant status of the birds

The meat cholesterol concentration of the groups fed with acid silage (fish waste) and surimi waste powder were not signif cantly d fferent from that of the control group fed with unsalted dried fish which proved to be advantageous The proximate analysis of the meat revealed that the crude prote n ether extract and total ash of the exper nental groups were s milar to that of control group indicating that meat quality s mainta ned w th these unconvent onal protein sources

There was no sign ficant difference n the serum sod um potassium calcium and iron content among the three groups At f fth week of age the magnes um level was sign f cantly h gher n acid silage group while at sixth week of age the b rds fed with processed fish wastes were hav ng significantly lower level than the control group but f nally at the end of the experiment (seventh week) tl ere was no s gnificant d ffe ence between any of the groups

It s obl gatory to use an mal prote n sources in bro ler cl icken ration for better growth performance F sh meal s the normal ingredient n the rat on since it s the source for the amino acids of an mal protein origin like lysine and methionine that are defic ent n the vegetable protein supplements but highly essential for proper growth and development of chicken But due to the high cost and low availability of f sh meal unconvent onal sources l ke f sh wastes are be ng tr ed as alternative source of animal prote n In the present study physio biochem cal effects of using processed fish wastes n the rat on of broiler chicken nstead of f sh meal were assessed They nduced a growth s m lar to that of the standard normal ration which contained fish meal as an mal prote n Thus the ncorporation of ac d s lage (fish waste) or sur m waste powder could be advocated to the farmers to reduce the feed cost to improve the prof t w thout affecting the growth and meat quality of broiler chicken and also as a measure to reduce environmental pollut on

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PHYSIO-BIOCHEMICAL EVALUATION OF BROILER CHICKEN FED WITH PROCESSED FISH WASTES

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ABSTRACT

The present study was undertaken to study the effect of dietary incorporation of processed fish wastes acid silage (fish waste) and surimi waste powder on the physio biochemical parameters in broiler chicken

The experiment was conducted on forty five day old broiler chicken of Vencob strain for a period of seven weeks After three weeks of age they were randomly divided into three groups G I G II and G III of 15 birds each During the first three weeks they were fed with standard broiler starter ration of BIS specification After three weeks G I was fed with the standard broiler finisher ration G II was fed with the standard broiler finisher ration in which there was 100 per cent replacement of unsalted dried fish with acid silage (fish waste) and G III was fed with the standard broiler finisher ration in which there was 100 per cent replacement of unsalted dried fish with surimi waste powder The rations of G I G II and G III were made isocaloric and isonitrogenous

Body weight and feed consumption were recorded at weekly intervals from fourth to seventh weeks of age Blood samples were collected fourth to seventh week from the three groups at weekly intervals and haematological and biochemical parameters were analysed Haematological parameters like Hb VPRC TEC TLC serum protein profile like total protein albumin globulin albumin globulin ratio serum lipid profile like total lipids triglycerides HDL VLDL NEFA total cholesterol serum enzymes like ALT AST antioxidants like blood catalase blood SOD serum GSH serum LPO serum electrolytes like Na K Ca Mg Fe were estimated At the end of the experiment the birds were sacrificed and giblet weight was assessed The meat of three representative samples from each group was used for analysing meat cholesterol and the proximate principles like crude protein ether extract and total ash

There was no significant difference between the three groups in body weight and feed consumption and they were gradually increasing during the experimental period in all the three groups The haematological parameters also were comparable between the control and experimental groups No significant difference was observed between the groups in the concentrations of total protein albumin and albumin globulin ratio throughout the study The concentration of globulin was significantly higher in the control group at the start of the study but later the values were significantly comparable between the three groups The concentrations of total lipids triglycerides NEFA VLDL and total cholesterol maintained a similar trend between the control and experimental groups but at the seventh week the concentration of HDL in the acid silage (fish waste) fed group was lower than that of the control group The concentrations of serum enzymes and minerals (Na K Ca and Fe) did not show any significant change between the three groups during the entire study Though the Mg level showed a fluctuating trend at fifth and sixth weeks of age at the end of the study there was no significant difference between any of the groups The antioxidant status was also significantly comparable between the groups The meat parameters like giblet weight meat cholesterol and the proximate principles were also significantly similar in the three groups

It is obligatory to use animal protein source in broiler chicken for obtaining better growth performance Fish meal is rich in certain amino acids essential for the proper growth of chicken that are limiting in the vegetable protein supplements Unconventional protein sources like fish wastes are to be used in the ration due to the high cost and low availability of fish meal In the present study physio biochemical effects of using processed fish wastes in the ration of broiler chicken instead of fish meal were assessed and they induced a growth similar to that of the standard normal ration which contain fish meal as animal protein Thus the incorporation of the two fish wastes could be advocated to the farmers to reduce the feed cost and improve the profit without affecting the growth and meat quality of broiler chicken and also as a measure to minimize environmental pollution