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Full Length Research Paper

Effect of various protein source feed ingredients on the growth performance of broiler

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The study was conducted to evaluate the growth performance of broilers in response to various percentages of animal protein (A.P) and plant protein (P.P) feed ingredients, kept at SAU, Tandojam. One hundred twenty **120 day old mixed chicks (male and female) were purchased for 42 days. Initially weighed and randomly divided in to 4 equal groups i.e. A, B, C, and D, each group having 30 chicks. They were fed different rations containing various percentages of A.P and P.P feed ingredients sources. Group A containing 20% A.P and 80% P.P (control), while group B, C and D were given 30/70, 40/60, and 50/50 percentages of A.P and P.P feed ingredients, respectively. It was noted that the different percentage of (A.P and P.P) animal protein and plant protein sources have significant (P<0.05) effect on the growth and economic parameters of broiler, but non-significant effect on edible and non-edible internal organs. The feed intake of broiler in groups A, B, C and D was 4203.37, 4240.21, 4283.98 and 4396.62 g/b; water intake (P<0.05) of broiler was 9.46, 9.51, 10.06 and 10.45 liter/b, respectively. Average live body weight (P<0.05) of broilers in groups A, B, C and D was 1896.25, 1952.39, 2022.32 and 2116.97 g/b; Feed conversion ratio was 2.03, 1.99, 1.93 and 1.84. Average carcass weight was 1138.80, 1176.60, 1252.20 and 1313.60 g/b; dressing percentage was 60.12, 61.88, 62.57 and 63.22; heart weight was 10.60, 11.00, 10.80 and 10.20 g/b; gizzard weight 56.40, 57.40, 58.80 and 59.20 g/b; liver weight 36, 38.40, 38.80 and 39 g/b and intestine weight 132.90, 137.20, 138.60 and 143.40 g/b, respectively. With increasing protein ratio of animal protein in broiler ration, there was significant (P<0.05) increase in feed and water consumption of broiler. It was observed that animal protein and plant protein percentages of 50:50% proved to be the most effective to increase broiler live body weight, improve feed conversion ratio, carcass quantity as well as net profit per broiler basis. However, there was no association of animal protein and plant protein source on the mortality rate of experimental broiler. It was concluded that 50:50 percentages of A.P and P.P feed ingredients could be considered as an optimum ratio for better broiler growth and economic profitability.**

Key words: Animal protein, Plant protein, Growth performance, Net profit, Broiler.

INTRODUCTION:

In Pakistan, the poultry sector generates employment for about 1.7 million people and poultry meat contributes 23.8 percent of the total meat production in the country. During the last three years, the poultry meat production in Pakistan was 601, 652 and Eggs 707 thousand tons, showing trend of gradual increase (GOP, 2010). A balanced diet is essential for good health, vigor and productive capacity of the people. Naseem *et al.,* (2006) used protein of plant origin using canola meal in broiler diets pelleted with five levels. Weight gain was higher in chickens fed diets containing 25% canola meal during two stages of growth. Odunsi *et al.*, (2007) examined the comparative utilization of 30% inclusion levels of three

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Table 1a: The broiler ration contained the following percentages of animal and plant origin protein sources in feed:

Protein source (%)	GROUPS			
	A (control)	B	C	D
Animal origin feed ingredients	20	30	40	50
Plant origin feed ingredients	80	70	60	50
Total	100	100	100	100

vegetable protein sources; Groundnut Cake (GNC); Soybean Meal (SBM) and Cotton Seed Cake (CSC) in the diets of broiler. Anwar *et al.,* (2008) examined effects of different protein sources including cottonseed meal and replacing soybean meal with varying proportions of cottonseed meal. Gu *et al.,* (2008) determined the effect of protein sources and levels (CP) on performance, carcass characteristics, meat visual quality, muscle chemical composition and malon-di-aldehyde (MDA) concentration of tissues in broilers. Yusuf *et al.,* (2008) investigated the use of plant protein to determine the effects on growth rate and economic of broiler fed decorticated fermented *Prosopis africana* seed meal and fat soybean meal fed to broiler for 8 weeks. That indicated 20% protein inclusion with soybean meal could be used in a broiler diet. Shokoufe *et al.,* (2010) studied the effects of different protein contents of diet on performance and growth. Davis, (2004) determined the potential nutritive value of the grain from the newly developed strains of rust resistant pearl millet, in order to identify those with the most potential dietary value for poultry feed.

There are two major sources of proteins, animal and plant proteins. The human diet in Pakistan is deficient in animal proteins, as approximately 66% (Maqbool, 2002). Protein is composed of smaller molecules called amino acids. There are 22 known kinds of amino acids. Different kinds of plants supply different amounts of these essential amino acids (Olomu, 1995). The main sources of animal proteins in Pakistan are beef, mutton, milk, poultry meat and eggs. Broiler meat is contributing a dominant share for meeting protein requirement in human diet. The broiler production needs to be enhanced by improving profitability of producers and by decreasing prices at the retail level (Maqbool *et al.*, 2005). The commonly available animal Proteins are fishmeal containing 60% of protein. Protein sources of animal origin are generally expensive and its use in animal feed is blood meal, bone meal, meat meal, feather meal, (DCP) die calcium phosphate. It is a major source of protein for poultry birds. The main source of plant protein is used soybean meal, sunflower cake, cottonseed cake and groundnut cake. Poultry diets are composed of natural feedstuffs, and can therefore be supplemented with small amounts of synthetic amino acids to meet the bird's requirements for the most limiting amino acids (Azarnik *et al.,* 2010).

Role of feed and nutrition for broiler production is as essential as management or animal itself, but its fiscal contribution surpasses all other aspects; a good nutrition plays a significant role for optimum production (NRC, 1984). During hot summer months, feed intake of birds is substantially reduced because of more heat production in the body. The search for alternative protein sources of feed ingredients as a partial or complete substitute to fish meal, a conventional costly ingredient in poultry rations has been long and tortuous. Demand for feed grade fish and fish meal significantly exceeds availability. Also due to the hazards of pathogenic salmonella contamination of late, most poultry feeds, especially breeder rations, are being formulated without supplementation of fish ingredients (Olomu, 1995). Upon considering the importance of various protein ingredients, this study was, therefore, carried out to investigate the effect of various protein sources feed ingredients on the growth of broiler.

MATERIALS AND METHODS

In order to investigate the effect of protein source feed ingredients on the growth of broiler, the study was carried out during the year 2010. A total of one hundred twenty (120) day old mixed sex broiler were purchased from commercial hatchery and brought to the Poultry Experimental Station, Department of Poultry Husbandry, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam. The chicks were initially weighed by using weighing digital scale and randomly divided into four groups i.e. A, B, C and D. each group having thirty (30) chicks. The broilers were fed on ration with both the protein sources i.e. animal origin (Bone meal, blood meal, and fish meal) and plant origin (maize, rice, rice polishing, guar meal, canola meal, sunflower meal, rape seed meal, corn gluten 30% , corn gluten 60% , (DCP) die calcium phosphate, and soybean meal). Further details are in under given tables 1a, 2a and 3a.

Management

Housing: The deep litter housing system was offered to the chicks, where one square feet space was provided to each chick. The poultry house was entirely cleaned,

Table 2a: The chemical composition of A.P and P.P protein feed ration for broiler groups A, B, C and D was maintained as per recommendation:

S#.	GROUPS	A	B	C	D
	Ratio of ingredients (%)	20/80	30/70	40/60	0/50
	Animal Origin Ingredients(#)	3	4	5	6
	Plant Origin Ingredients(#)	9	8	7	6
1	Blood meal	1	1	1	1
2	Bone meal	2	2	2	2
3	Fish meal	3	3	3	3
4	Feather meal	-	4	4	4
5	DCP	-	-	5	5
6	Meat meal	-	-	-	6
7	Rice	1	1	1	1
8	Maize	2	2	2	2
9	Canola meal	3	3	3	3
10	Soybean meal	4	4	4	4
11	Corn Gluten 30%	5	5	5	5
12	Corn Gluten 60%	6	6	6	6
13	Rap seed cake	7	7	7	-
14	Guar meal	8	8	-	-
15	Limestone	9	-	-	-
Total:		100	100	100	100

Table 3a: Chemical composition of rations (%):

CP	22	22.4	22.4	22.5
ME	2848	2843	2861	2897
Ca	1.7	1.2	1.33	1.29
P	1	0.7	0.76	0.766
ASH	7.8	6.6	6.9	7.2

Table 4a: Vaccination schedule:

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Days	Vaccines	Route of Administration
1 – 3	N.D + I.B	ED
10 – 12	I.B.D	ED/DW
16 – 17	H.P.S	Sub cut ½ cc
22	I.B.D	D/W
28	N.D	D/W

washed with fresh water and disinfectant. Before housing the chick's entire shed was coated with limestone and left to dry over 24 hours. The recommended temperature and humidity was maintained throughout the experimental period and recorded.

Brooding: The artificial brooding preparation was completed well before the arrival of day old chicks. One brooder was provided to each group and in the first week, brooding temperature was maintained between 90 to 95^0F and 5^0F reduced week till the house temperature reached $70.^0$F. During brooding 40/60 watt electric bulbs were fitted in to electric brooder and placed in the centre of each allocated area. One thermometer was placed at the height of 6-12 inch near the brooder to maintain the brooding temperature.

Lighting: The lighting was provided by using 40/60 watt bulbs which were fitted with roof at the height of 8 feet. However, florescent tube light/charger or florescent tube was used at the time of light failure to maintain 24 hours lighting.

Litter Management: The wooden dust was used as litter; before spreading it on the floor, the litter was dried under sunlight for over 12 hours and checked before taking out its thick material so as to maintain litter quality. Litter was used at 2-4 inches depth for each group of broiler. The lime stone was mixed with litter to check the infection and litter turning was practiced 2-3 times a day to minimize the gas production in the shed to ground level.

Vaccines and Vaccination: The following vaccines were purchased and used for vaccination from time to time through different routes of administration of drugs as given in table 4a.

Parameters studied

Water intake (ml): Fresh water was provided to the

Table 1b. Feed consumption (g/b) of broiler as influenced by various percentage (%) of protein source feed ingredients.

Weeks	Groups			
	A	B	C	D
1	151.54	158.65	154.65	152.85
2	305.45	291.65	288.54	280.65
3	503.54	586.54	580.95	572.97
4	886.65	846.65	942.52	939.65
5	1055.65	1055.85	1074.56	1075.65
6	1300.54	1300.87	1242.76	1274.85
Total	4203.37 [c]	4240.21 [b]	4283.98 [a]	4296.62 [a]

Table 2b. Water intake (ml/b) of broiler as influenced by various percentage (%) of protein source feed ingredients.

Weeks	Groups			
	A	B	C	D
1	547.06	588.59	657.26	689.35
2	1194.31	1140.35	1226.30	1265.73
3	1968.84	2293.37	2469.04	2584.09
4	3466.80	3310.40	4005.71	4237.82
5	4127.59	4128.37	4566.88	4851.18
6	5085.11	5086.40	5281.73	5749.57
Total	16389.71 [c]	16547.49 [c]	18206.92 [b]	19377.76 [b]

broiler twice daily. Refusal of water was collected, measured and subtracted from water offered and finally consumed water was recorded daily.

Feed intake: Feed was provided *ad libitum* to the broiler, given twice daily and refusal of feed was collected from feeders of each group and weighed and finally consumed feed was noted daily.

Mortality: Dead birds were collect when observed, the mortality was recorded and the mortality rate was calculated.

Live body weight: After arrival of day old chicks at Poultry Experimental Station, individual chick was weighed by using electric weighing scale and later broiler was weighed at the completion of each week.

Carcass weight: On the completion of 42 days of age of broiler, 5 broilers from each group were weighed and slaughtered. After dressing, the carcass weight was recorded and its dressing percentage was calculated.

Weight of edible and non-edible parts: After slaughtering of 5 broilers from each group the liver, heart, gizzard, and intestine were removed / separated with the help of scalpel and scissor and were weighed in electric weighing balance separately and recorded.

Data analysis: The collected data from the study were tabulated and subjected to statistical analysis by using standard statistical computer package as suggested by Gomez and Gomez (2000).

RESULTS:

Feed consumption: Feed consumption of broilers in groups A, B, C and D fed on ration formulated at recommended protein level using different percentages of (A.P) and (P.P) protein sources was 4203.37, 4240.21, 4283.98 and 4296.62 g/b, respectively (Table-1b). The feed consumption was relatively higher in groups D, where animal protein (A.P) plant protein (P.P) sources were used at percentages of 50:50 while lowest feed intake was recorded in group A.

Irrespective of rations of protein sources, the feed consumption of broiler rapidly increased with development of their age and differences between weeks for feed consumption were significant ($P<0.05$). The LSD test suggested that the differences for feed consumption between groups statistically significant ($P>0.05$), (Table-1b). The results further suggested that increasing protein of animal origin up to 50:50% in feed probably increased the feed palatability and the broiler consumed relatively more feed as compared to feed with high percentage of plant origin protein.

Water intake: The water intake of broilers in groups A, B, C and D was 16389.71, 16547.49, 18206.92 and 19377.76 ml/b, respectively (Table-2b). The water intake of broiler was significantly increased in group D, while water intake reduced considerably in group A.

Statically the differences for water intake were highly significant between groups. The broiler consumed more feed and also improved its thrust and in the result broiler fed ration with higher percentage of animal protein consumed more water than lower animal protein percentage in feed. The LSD test indicated that the differences for water intake between groups were statistically significant ($P>0.05$), as shown in Table-3b. It is evident from the results that increasing protein of animal origin up to 50:50 ratio in ration, the thrust of broiler improved which is a healthy sign from broiler health point of view and they took more water as compared to those took low animal protein feed.

Live Bodyweight: The live body weight of broilers in groups A, B, C and D was 1896.25, 1952.39 2022.32, 2116.97 and g/b, respectively (Table-3b). There was remarkable positive effect of increasing protein of animal

Table 3b. Live body weight (g/b) of broiler as influenced by various percentage (%) of protein source feed ingredients.

Weeks	Groups			
	A	B	C	D
1	133.20	124.40	128.00	139.20
2	161.90	182.50	197.41	205.70
3	347.30	350.40	358.20	363.40
4	401.85	423.40	441.32	447.10
5	410.15	426.54	435.65	495.70
6	441.85	445.35	461.54	465.87
Total	1896.25	1952.39	2022.32	2116.97

Table 4b. Feed Conversion Ratio (FCR) of broiler as influenced by various percentages (%) of protein source feed ingredients.

Weeks	Groups			
	A	B	C	D
1	1.14	1.19	1.16	1.15
2	1.89	1.68	1.50	1.33
3	1.45	1.67	1.62	1.58
4	2.21	2.00	2.14	2.10
5	2.57	2.48	2.47	2.17
6	2.94	2.92	2.69	2.74
Mean	2.03 ^{b}	1.99 ^{b}	1.93 ^{a}	1.84 ^{a}

Table-5. Carcass weight (g/b) of broiler as influenced by various percentage (%) of protein source feed ingredients.

Weeks	Groups			
	A	B	C	D
1	1078.00	1165.00	1264.00	1332.00
2	1066.00	1198.00	1245.00	1287.00
3	1066.00	1235.00	1288.00	1354.00
4	1219.00	1175.00	1254.00	1345.00
5	1265.00	1110.00	1210.00	1250.00
Mean	1138.80 ^{b}	1176.60 ^{b}	1252.20 ^{b}	1313.60 ^{a}

origin over plant origin and the live bodyweight was significantly increased in group D, while live body weight decreased significantly and the lowest live body weight was found with animal protein (A.P), plant protein (P.P) percentage 20:80.

The live bodyweight of broiler was significantly increased ($P<0.05$) with the progress in their age and differences for live body weight between weeks was significant ($P<0.05$). It is evident from the results that each increasing unit in the ratio of animal origin protein, the live body weight of broiler increased significantly ($P<0.05$), which might have association with the feed consumption, because the broiler in groups of high animal protein ratio, also consumed more feed as compared to low animal protein ratios. However, A.P and P.P protein ratio of 50:50 in broiler ration supposed to be the best A.P and P.P protein combination to maximize the live body weight in broiler.

Feed Conversion Ratio (FCR): Feed conversion ratio of broilers in groups A, B, C and D was 2.03, 1.99, 1.93 and 1.84, respectively (Table-4b). The results showed that the effect of increasing animal protein sources over plant protein sources in broiler feed had significant and positive effect on FCR and the most efficient FCR was found in broilers of group D, while feed conversion ratio was poor in group A with animal protein (A.P) and plant protein (P.P) percentages 20:80.

The differences in FCR for weeks indicated that with the development of broiler age, the FCR was significantly ($P<0.05$) improved. The results further indicated that increasing animal protein in feed showed remarkable effect on FCR ($P<0.05$). The LSD test suggested that the differences in FCR between groups was significant ($P>0.05$), The study suggested that anima protein (AP) and plant protein (PP) percentages of 50:50 would be optimally better over any other combination for achieving most efficient FCR in broilers.

Carcass weight: The carcass weight of broilers in groups A, B, C and D was 1138.80, 1176.60, 1252.20 and 1313.60 g/b, respectively (Table-5). The results showed that the highest carcass weight of 1313.60 g/b was obtained from the broiler fed ration with (AP) and (PP) percentages of 50:50 in group D, while the lowest carcass weight was obtained when fed on ration with AP and PP percentages of 20:80 in group A.

It is apparent from the data in (Table-5) that increasing in the ratio of animal protein, the carcass weight of broiler increased significantly ($P<0.05$). The LSD test indicated that the significant differences in carcass weight between among the groups ($P>0.05$), the study showed that animal: plant protein ratio of 50:50 would be optimally better over any other combination for obtaining high quality broiler meat.

Dressing percentage: Dressing percentage of broilers in groups A, B, C and D was 60.12, 61.88, 62.57, and 63.22 percent, respectively (Table-6). It is clear from the results that the highest dressing percentage of 63.22 was recorded in broiler fed ration with animal protein (A.P) plant protein (P.P) ratio of 50:50, while the lowest dressing percentage was obtained when fed on ration with animal protein (A.P) plant protein (P.P) ratio of 20:80.

The statistical analysis showed that the differences in dressing percentage under different animal protein

Table-6. Dressing percentage of broiler as influenced by various percentage (%) of protein source feed ingredients.

Weeks	Groups			
	A	B	C	D
1	60.22	61.97	63.68	63.28
2	61.05	65.11	63.36	64.19
3	51.77	62.37	62.37	63.27
4	60.95	62.33	63.11	65.48
5	66.58	57.60	60.35	59.87
Mean	60.12	61.88	62.57	63.22

Table-7. Mean Weight of edible and non-edible parts (g/b) of broiler as influenced by various percentage (%) of protein source feed ingredients.

Groups	Heart	Gizzard	Liver	Intestine
A	10.60	56.40	36.00	132.90
B	11.00	57.40	38.40	137.20
C	10.80	58.80	38.80	138.60
D	10.20	59.20	39.00	143.40

Table-8. Average mortality (%) of broiler of broiler as influenced by ration of different protein sources.

Parameter	Groups			
	A	B	C	D
No: of birds	30	30	30	30
Dead broiler (#)	2	3	2	1
Mortality (%)	6.66	10.00	6.66	3.33

(A.P) plant protein (P.P) ratios were non-significant (P>0.05). The study showed that animal protein (A.P) plant protein (P.P) ratio of 50:50 is better than group A 20:80 (protein percentages) dressing percentage in broiler. Moreover, the significance of differences in average dressing percentage between groups is negatively affected by higher variation in dressing percentage of broiler within same groups.

Weight of internal organs: Weight of internal edible and non-edible parts such as heart, gizzard, liver and intestine weight was also recorded on the basis of five slaughtered broiler after 6 weeks and the results are shown in table-7. The results showed that the heart weight of broiler in groups A, B, C and D was 10.60, 11.00, 10.80 and 10.20 g/bird, weight of gizzard 56.40, 57.40, 58.80 and 59.20 g/bird, weight of liver 36.00, 38.40, 38.80 and 39.00 g/bird and intestine weight 132.90, 137.20, 138.60 and 143.40 g/bird, respectively .

Table-9. Economics of experimental rations.

Particulars	A	B	C	D
Day-old chicks (Rs)	58.00	58.00	58.00	58.00
Feed consumed (kg)	4.20	4.24	4.284	4.296
Rate of feed (Rs)	27.00	27.50	28.00	29.00
Feed cost (Rs)	113.40	116.60	119.84	124.41
Medication (Rs)	10.00	10.00	10.00	10.00
Litter cost (Rs)	2.10	2.10	2.10	2.10
Limestone (Rs)	1.00	1.00	1.00	1.00
Labour cost (Rs)	15.00	15.00	15.00	15.00
Misc. (Rs)	5.00	5.00	5.00	5.00
Total cost (Rs)	204.50	207.70	210.94	215.51
Final LBW (kg)	1.896	1.952	2.022	2.117
Marketing price (Rs)	119.00	119.00	119.00	119.00
Total Income (Rs)	225.65	232.33	240.65	251.92
Net profit (Rs)	21.12	24.58	29.68	36.41

It was observed that the heart weight remained unaffected due to variation in the origin of protein and its ratio in feed, while gizzard ratio was slightly increased with increasing animal protein ratio in feed. Similarly, liver weight was also slight increased under increased ratio of animal protein in feed and intestine weight was considerably increased with increasing animal protein ratio in feed. However, statistically the differences for hear, gizzard, liver and intestine weight under different animal: plant protein ratios in feed were non-significant (P>0.05).

Mortality rate: Average mortality of broiler in groups A, B, C and D was 2, 3, 2 and 1 birds per group, and the rate of mortality remained 6.66, 10.00, 6.66 and 3.33 percent, respectively (Table-8). There was no association of ratio and source of protein on the mortality rate and the observed mortality might be associated with the management or mishandling of the birds.

Economics: The economics of rations formulated by different ratios of different protein sources was calculated and the outcome is presented in table-9. It was noted that the total income from the broiler in groups A, B, C and D, fed ration with animal: plant protein ratios of 20:80, 30:70, 40:60 and 50:50 was Rs. 225.65, Rs. 232.33, Rs. 240.65 and Rs. 251.92/b, against the total production cost of Rs. 204.50, Rs. 207.70, Rs. 210.94 and Rs. 215.51/b, generating the net profit of Rs. 21.12, Rs. 24.58, Rs. 29.68 and Rs. 36.41/b, respectively. It was noted that broiler in group-D (50:50 animal: plant protein ratio) was economically more profitable due to weight gained than other treatment groups.

DISCUSSION:

Animal protein is a rich source of energy, and it is help full in the growth of animal body, animal protein is a

complete protein as compare to plant protein, because animal protein is having a complete essential amino acid as compare to plant protein. While, animal protein is easily available in the market. Animal body is largely composed of proteins, which are composed of smaller molecules called amino acids (Olomu, 1995). Animal protein and plant protein are generally used in broiler feed, but recently synthetic sources have also proved beneficial effects on growth of broiler.

Feed Intake: The result of present study showed that highest feed consumed by the broiler of group D, where the ration was formulated with animal protein and plant protein source ratio 50:50 percentages and lowest feed consumption was recorded in broiler of group A ,fed on ration contained animal protein and plant protein source ratio 20:80 percentages. The results are well accordance to Oduguwa *et al*, (2004), they reported that daily feed intake of the broiler fed animal protein based diets was significantly ($P<0.05$) higher than those of other treatment.

Water Intake: Trend of water intake of the broiler of different groups was significant to that of feed intake. The maximum water was consumed by the broilers of group D, (A.P and P.P ratio 50:50 %) which also consumed ore amount of feed as compared to other groups. Ugwuene and Omueti, (2002) compared the performance of broiler birds fed indicated that feed intake and weight gain of the birds fed with rations containing 5% fish meal, and 2.5 and 10% chicken intestine meal were significantly different from each other.

Live Bodyweight: The highest weight gain was recorded in broiler of groups D, where (AP and PP) protein source ratio 50:50 % was used. In spite of difference in the mode of the ratio of AP and PP source, the results of the experiment showed highly significantly differences between the control group A and other groups ($P<0.05$) in live weight gain during the six week study period. The result reported by Metwally, (2004) and Memon *et al.*, (2005) also showed similarity with the present results. They reported that increase in the animal protein source percentages in limited ratio also increase the live body weight.

Feed Conversion ratio: Feed conversion ratio is considered as one of the leading quality parameter and progress or development is generally associated with feed efficiency in poultry production. The results for FCR ratio was better in broilers of group D, provided feed containing animal protein and plant protein source ratio is 50:50. Where as the poorest feed conversion ratio was recorded in-group A (control group). These results are further supported by findings of Nawar and El-Sayed, (2003). They concluded that live weight gain and feed conversion efficiency were higher in chickens fed on animal protein. The broiler in-group D was observed to be apparently more efficient and economical in feed consumption and conversion per unit live weight gain than the birds in other groups.

Dressing Weight: The results showed that the dressing percentage increased with the increase of animal protein in the ration with ratio 20:80, 30:70, 40:60, and 50:50. The results reported by Memon *et al*., (2005) also showed similarity with the present results. They reported that increasing the animal protein to a certain limit increased the dressing percentage.

Giblet Weight: The weight of giblets (liver, heart and gizzard) of group D (A.P and P.P 50:50 ratio) is slightly higher because the broilers of group D were heavier as compared to broilers of groups A (A.P and P.P 20:80% control), B (A.P and P.P 30:70 %), C (A.P and P.P 40:60%). The analysis of results regarding giblets weight showed non-significant difference in the broilers fed on different A.P and P.P percentage in ration. The results of the present study for weight of giblets are in agreement with those of Ojewola, *et al*., (2005). They reported that weight of the gizzard, liver, kidney, and heart was not significantly ($P>0.05$) affected and indicated that satisfactory animal protein could be prepared from unconventional sources.

Mortality: The lowest mortality (3.33%) was recorded in broilers of group D fed on ration containing 50:50 (AP and PP source); while maximum mortality was observed in broiler of group B fed on ration containing 30:70 (AP and PP source). The results showed that average mortality did not show any association either with the weeks or with the ration provided with various animal protein and plant protein sources. supporting the result of present investigation Ugwuene and Omueti, (2002) argued that mortality of the birds fed with rations containing various animal protein and plant protein sources were not significant different ($P>0.05$) from each other.

Economics: This study revealed that animal protein sources administration in the broiler feed is a beneficial up to 50:50 % (group D). The administration of animal protein source in broiler ration below 50:50% did not have economical effect on net profit of the flock. The results of the present investigation are further supported by the observation of Memon *et al*., (2005) who also had similar experience regarding economics and they reported that the net profit was higher in broiler fed rations containing 50:50 % ratio of AP % PP as compared to the other groups. These results are further supported by finding of Ibrahim, (2002) who concluded that better economic efficiency was obtained in chicken given local poultry slaughterhouse by-product meat meal, blood meal, bone meal, feather

meal in feed and obtained high net profit due to better feed efficiency.

Weight of internal edible and non-edible parts such as heart, gizzard, liver and intestine weight, the heart weight of broiler in groups A, B, C and D fed ration with AP and PP protein ratios was 10.60, 11.00, 10.80 and 10.20 g/bird, weight of gizzard 56.40, 57.40, 58.80 and 59.20 g/bird, weight of liver 36.00, 38.40, 38.80 and 39.00 g/bird and intestine weight 132.90, 137.20, 138.60 and 143.40 g/bird respectively. Average mortality of broiler in groups A, B, C and D was 6.66, 10.00, 6.66 and 3.33 percent in groups respectively. It was noted that broiler in group-D (50:50 AP and PP protein ratio) was economically more profitable due to better weight gain than other treatment groups. It was concluded that broiler ration may be formulated as 50:50 ratio of animal protein and plant protein origin feed ingredients for better FCR, dressing percentages and per bird net profit as compare to other rations.

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