COMPARATIVE PERFORMANCE OF BROILER CHICKS ON COMMERCIAL AND CORN-SOYBEAN MEAL BASED RATIONS

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Summary

A study was conducted to compare the effect of feeding commercial formula ration and corn-soybean meal based rations on growth performance, feed conversion ratio, mortality percentage, dressing percentage, carcass composition and economics of raising broiler chicks at commercial farms. 3000 day old broiler chicks were randomly divided into 4 groups with 3 replicates of 250 birds in each. Four iso-nitrogenous and isocaloric rations (A, B, C and D) were prepared and randomly allotted to each group. Ration A was a commercial broiler ration whereas ration B had the same formula with the exception that all the animal protein sources were replaced with soybean meal (SBM). Ration C was based on only corn and SBM. Ration D contained corn, SBM and 25% fullfat soybeans (FFSB). The birds were given the experimental rations starter from day 1 to 28 and finisher from 29 to 49. The results indicated that the birds fed on corn-soybean meal based rations gained significantly higher weights showed better feed conversion ratio, gave higher dressing percentage with better carcass composition, lower mortality and higher net profits as compared to those fed on commercial ration. The replacement of animal protein sources in commercial ration with SBM (ration B) although did not show any significant differences in the performance of birds as compared to ration A, a little improvement was visible indicating that SBM can be used as a good substitute of animal protein sources. Similarly the replacement of SBM with FFSB up to a level of 25% did not affect the broiler performance as compared to only SBM.

(**Key Words**: Soybean Meal, Full Fat Soybeans, Corn-soybean Meal Ration, Feed Conversion Ratio, Broiler Chicks)

Introduction

A large variation in the quality of locally available feed ingredients is a major constraint towards the formulation and production of high quality balanced rations for poultry in Pakistan. Cereal grains and milling by-products like maize, wheat, broken rice, wheat middlings, rice polishings etc. are mainly used as sources of energy whereas fish meal, blood meal, meat meal and oilseed meals (like cotton seed meal, rapeseed meal, corn gluten meal, maize oil cake, sunflower seed meal etc.) are used as protein sources. Utilization of low quality and poorly processed feedstuffs affects the overall feed efficiency of rations. The findings of a study carried out by the Economic Analysis Network in collaboration with the USAID (1987), indicated that when local protein and energy feed ingredients are in short supply the soybean meal and fullfat soya would become the lowest cost protein and energy feed alternatives. It has been suggested that the responsiveness of poultry production to improved feeds be demonstrated to farmers.

Soybean meal is a unique source of plant seed protein that contains high quantities of lysine i.e., 6.7% of its crude protein content. The bio-availabilities of amino acids to poultry from commercially produced soybean meals range from 80 to 94% (Garlich, 1988). The availability of amino acids in animal protein meals appears to be lower and variable than soybean meal. However, the relative lysine value of either meat or bone meal, fish meal and blood meal is higher when based on total lysine as compared to digestible and available lysine (Parsons, 1986). Veltmann et al. (1986) reported that the nutritive value of commercially processed soybean meal (SBM) should be assessed not only on the basis of *in vitro* tests but also on the basis of chick

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biological tests. The formulation of commercial poultry rations should therefore be based on available amino acid values of feed ingredients as the protein quality of these ingredients may vary greatly depending upon the raw material and processing methods.

Okan and Ogun (1986) compared the biological value of soybean meal and fish meal for broiler starter rations. They concluded that soybean meal supplemented with methionine can replace fish meal in starter ration. Haq et al. (1986) fed broiler chickens up to the age of 5 weeks, a control diet containing 12% fish meal and 3 experimental diets replacing fish meal with 4, 8 and 12% soybean meal. They reported no significant differences among the groups in weight gain, feed intake and feed efficiency. Very little information is, however, available on assessing the performance of broilers when fed on only corn-soybean meal based rations as compared to multi-ingredient based commercial formula rations. The present study was thus conducted to compare the effect of feeding commercial formula ration and corn-soybean meal based rations on the growth performance, feed conversion ratio dressing percentage, carcass composition, mortality and economics of raising broiler chicks at commercial farms.

Materials and Methods

3000 day old broiler chicks were used for this study. The birds were randomly divided into 4 group with 3 replicates of 250 birds in each replicate. All the birds were given standard management practices for watering, feeding and disease control. Four experimental rations (A, B, C and D) were prepared (table 1 and 2) and were randomly allocated to 3 replicates in each group. The chemical composition of the rations is given in table 3 and 4. Ration A was a commercial broiler ration and acted as control. Ration

TABLE 1. COMPOSITION OF RATIONS (BROILER STARTER)

Ingredients/Rations	A	B	C	D
		%		
Maize	20.0	20.0	59.5	53.5
Wheat	14.0	14.0	–	–
Broken rice	20.0	20.0		
Rice polishings	8.0	6.0	–	–
Soybean meal[1] (SBM)	–	14.0	36.0	17.0
Full fat soybeans[2] (FFSB)	–	–		25.0
Fish meal[3]	10.0	–	–	–
Blood meal	2.0	–	–	–
Maize gluten meal 60%	7.0	7.0		–
Cotton seed meal	8.5	8.5	–	–
Guar meal (toasted)	4.5	4.5	–	–
Molasses	3.8	3.8		–
Mineral-Vitamin Mix.[4]	1.0	1.0	1.0	1.0
Dicalcium hydrogen phosphate (DCP)	1.0	1.0	1.9	1.9
Limestone	–	–	1.3	1.2
Salt (NaCl)	0.2	0.2	0.2	0.2
Methionine	–	–	0.1	0.1
Total:	100.00	100.00	100.00	100.00

[1] Soybean seeds, meal solv. extd. (% DM) 50.0% C. P. and 4.64% ether extract.

[2] Soybean seeds heat processed (% DM) 41.86% C. P. and 21.49% ether extract.

[3] Fish meal 42% C. P.

[4] Composition of min. vit. mix (Per kg). Vit. A, 14000 IU; Vit. D, 3000 IU; Vit. E, 11 IU; Vit. K, 5.0 mg; Vit. B_1, 1.5 mg; Vit. B_2, 6.0 mg; Vit. B_6, 3.0 mg; Vit. B_{12}, 12 mg; d-Panthoacid, 12 mg; Niacin, 30 mg; Folic acid 0.7 mg; Choline, 700 mg; Mn. 75 mg; Fe, 75 mg; Zn 75 mg; Cu 8 mg; I 1.0 mg and Selinum 0.1 mg.

TABLE 2. COMPOSITION OF RATIONS (BROILER FINISHER)

Ingredients/Rations	A	B	C	D
			%	
Maize	20.0	20.0	64.7	59.0
Wheat	14.0	14.0	–	–
Broken rice	20.0	20.0	–	–
Rice polishings	12.5	11.0	–	–
Soybean meal (SBM)	–	11.0	31.0	12.0
Full fat soybeans (FFSB)	–	–	–	25.2
Fish meal	6.5			–
Blood meal	2.0	–	–	–
Maize gluten meal 60%	6.0	5.0	–	
Cotton seed meal	8.5	8.5	–	–
Guar meal (toasted)	4.5	4.5	–	–
Molasses	3.8	3.8	–	
Mineral-vitamin mix.	1.0	1.0	1.0	1.0
Dicalcium hydrogen phosphate (DCP)	1.0	1.0	1.7	1.7
Limestone		–	1.3	0.8
Salt (NaCl)	0.2	0.2	0.2	0.2
Methionine	–	–	0.1	0.1
Total:	100.00	100.00	100.00	100.00

TABLE 3. CHEMICAL COMPOSITION OF RATIONS (BROILER STARTER)

Parameters	A	B	C	D
Dry matter %	88.37	88.68	88.22	87.66
On % DM basis				
Crude protein	22.96	22.74	22.41	22.30
Crude fiber	4.75	5.41	2.75	3.31
Ether extract	4.28	2.60	2.62	6.71
Total ash	9.42	6.76	6.50	6.36
Calcium (Ca)	1.27	1.31	1.02	1.00
Phosphorus (P)	0.85	0.89	0.45	0.46
Lysine	1.26	1.18	1.29	1.27
Meth & Cys	0.77	0.74	0.85	0.82
Tryptophan	0.21	0.23	0.26	0.24
ME (Kcal/kg)	2935	3004	2915	2988

B had the same commercial broiler ration formula with the exception that all the animal protein sources were replaced with soybean meal (SBM). Ration C was based on corn and SBM. Ration D contained corn, SBM and fullfat soybean meal (FFSB). The birds were given the experimental rations starter from day 1 to 28 and finisher from 29 to 49. Data on daily feed consumption, weekly body weight gain, weekly mortality, general flock performance and production costs were recorded. At the end of the feeding trial 3 birds from each replicate were randomly selected and slaughtered to determine the dressing percentage. Representative samples of breast muscles were taken to analyse their chemical composition. The birds were kept off feed for 16 hours before the slaughtering. The proximate chemical composition of feed and meat was carried out using the methods of

TABLE 4. CHEMICAL COMPOSITION OF RATIONS (BROILER FINISHER)

Parameters	A	B	C	D
DM %	88.32	88.67	88.57	88.75
On % DM basis				
Crude protein	20.50	20.66	20.47	20.40
Crude fiber	5.36	5.77	2.71	3.29
Ether extract	4.17	2.94	2.77	6.90
Total ash	8.90	7.12	6.11	6.91
Calcium (Ca)	1.26	1.30	0.86	0.80
Phosphorus (P)	0.85	0.89	0.45	0.46
Lysine	1.26	1.18	1.29	1.27
Meth & Cys	0.63	0.67	0.76	0.73
Tryptophan	0.19	0.21	0.23	0.22
ME (Kcal/kg)	2918	2938	2924	3041

AOAC (1984). The data so collected were subjected to statistical analysis using analysis of variance technique (Steel and Torrie, 1980).

Results and Discussion

The results on feed consumption, weight gain, feed conversion ratio, mortality and dressing percentage are given in table 5. Non-significant differences were observed in the average feed consumption of birds on various experimental rations. However, there have been significant differences in the weight gain of birds fed on rations C and D as compared to rations A and B. Although the birds fed on ration B where all the animal protein sources (i.e., fish meal and blood meal) of commercial ration were substituted with SBM showed slightly better weight gains as compared to those fed on commercial ration, the results were non-significant. In general, the birds fed on ration A consumed more feeds as compared to those on rations B, C and D but gained less weight. The values obtained for feed conversion ratio (FCR) indicated similiar pattern. Rations C and D showed significantly better FCR values as compared to rations A and B. Although the FCR values for ration B were slightly better than ration A (2.61 vs. 2.81 respectively), the results were non-significant.

The results on dressing percentage of birds also showed similar trends and significantly better dressing percentages were obtained for birds given rations C and D. The results on average feed consumption, weight gain, FCR and dressing percentage correlate well with each other. The rations which gave better FCR values produced

TABLE 5. EFFECT OF FEEDING CORN-SOYBEAN MEAL BASED RATION ON THE GROWTH PERFORMANCE, FEED EFFICIENCY AND DRESSING PERCENTAGE OF BROILER CHICKS

Parameters/Rations	A	B	C	D	S.E.
Ave. feed consumed/ bird (kg)	4.13	4.05	3.87	3.91	0.07
Ave. weight gain/ bird (kg)	1.47[a]	1.55[a]	1.71[b]	1.75[b]	0.02
Feed conversion ratio	2.81[a]	2.61[a]	2.26[b]	2.23[b]	0.04
Dressing (%)	67.33[a]	68.20[a]	70.04[b]	70.34[b]	1.18
Mortality (%)	18.67[a]	10.54[b]	11.78[b]	10.78[b]	1.36

[a,b] Mean values in the same row with different superscripts differ significantly $p < 0.05$.

more meat by giving better dressing percentages. Maximum bird mortality was observed in group A fed on commercial ration and it was statistically significant as compared to other groups. There were, however, no significant differences in the mortality percentage of birds on rations B, C and D.

The trends on average weekly feed consumption, weight gain and mortality percentage are shown in figure 1, 2 and 3 respectively. During the first 4 weeks, the average weekly feed consumption in birds on all the experimental rations increased gradually and showed similar trends. There was no increase in the feed consumption of birds on all the rations during the 4th and 5th week. During the 6th and 7th week the feed consumption of birds again increased and the differences in the feed consumption

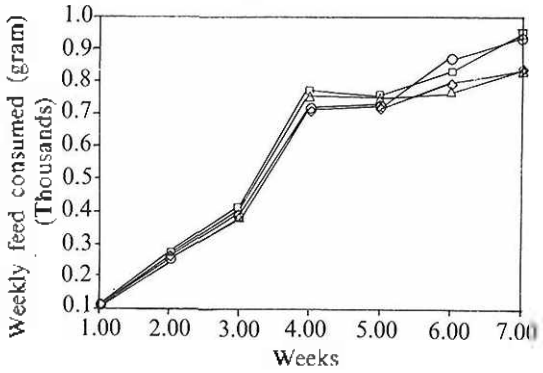

Figure 1. Effect of various experimental ration on the weekly feed consumption of birds.

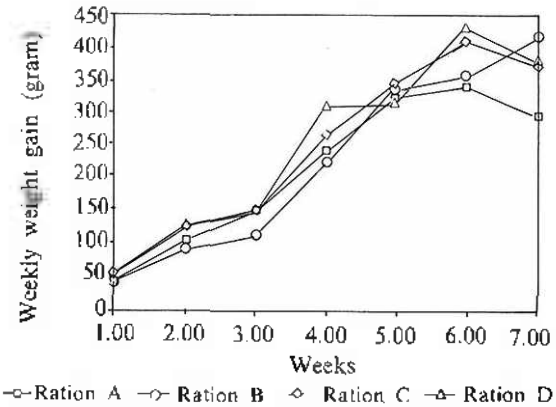

Figure 2. Effect of various experimental rations on the weekly weight gain of birds.

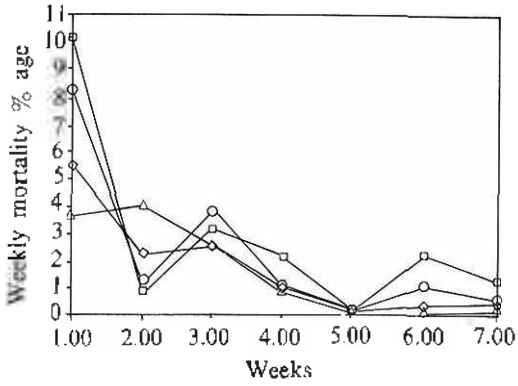

Figure 3. Show the weekly morta ity % age of birds on various experimental rations.

pattern of various groups appeared. However, as already stated the results on the overall average feed consumption of birds for various rations were non-significant. The weekly weight gain pattern of birds on various rations was very much similar to that of feed consumption. With the exception of birds in group 2 (ration B) which continuously showed the upward trend for increased weekly weight gains also in the 7th week, the birds in the other groups showed slightly less weight gains in the 7th week as compared to 6 th week. This shows that it is not advisable to carry on keeping the broilers beyond the 6th week as the birds consumed more feed and gained less weight during the 7th week. This may reduce the overall profit margins.

Figure 3 shows the weekly percentage mortality of birds on various experimental rations. Highest bird mortality was observed during the 1st week of experiment, whereas in the subsequent weeks, the rate of mortality was satisfactorily low. The trends were almost similar in all the groups. The results indicated that the brooding period is the most critical one as after the 3rd week the percentage bird mortality dropped significantly.

The results on the chemical composition of meat are given in table 6. There were non-significant differences in the dry matter, ether extract and total ash content of meat of birds fed all the 4 rations. However, the rations affected significantly the crude protein content of the meat. The birds fed on corn soybean meal based rations had significantly higher crude protein content in their muscles as compared to those fed on com-

TABLE 6. EFFECT OF FEEDING COMMERCIAL AND CORN-SOYBEAN MEAL BASED RATIONS ON MEAT COMPOSITION OF BROILER CHICKS (IN %)

Parameters/Rations	A	B	C	D	S.E
Dry matter	27.83	28.69	28.79	28.41	0.96
Crude protein	20.76[a]	21.75[ab]	22.52[b]	22.61[b]	0.78
Ether extract	2.40	2.42	2.40	2.31	0.05
Total ash	2.18	1.47	1.43	1.48	0.13

[a,b] Row means that do not have common superscripts differ $p < 0.05$.

mercial ration. The crude protein content of the meat of birds fed on ration B was slightly higher than that of the birds fed on ration A but lower than that of the birds fed on rations C and D. The results were, however, non-significant. The results on the meat composition also correlate well with those on weight gain, feed conversion ratio and dressing percentage.

All the 4 rations (A, B, C and D) were iso-nitrogenous and isocaloric. Significantly better performance of birds on corn-soybean meal based rations indicate that the bioavailability of nutrients from these rations might have been better as compared to commercial ration. The replacement of animal protein sources (fish meal and blood meal) with SBM in commercial ration seems to have improved the nutritive value of ration B, as the birds fed on this ration though not significantly showed slightly better performance as compared to commercial ration. This indicates that SBM can replace fish meal or other animal protein sources in broiler rations.

The commercial ration contained 10 ingredients excluding mineral-vitamin mixture and salts. Whereas corn-soybean meal based rations contained only either corn and SBM or corn with SBM and FFSB. The inferior performance of broilers fed on rations A and B might have resulted from lower methionine and cystine content as well as poor quality energy sources in these rations. The associative effects of various feed ingredients might have also affected the availability of nutrients from these feedstuffs (Hoover and Miller, 1991). The amino acid distribution of soybean meal appears to be such that in combination with corn and necessary mineral and vitamin supplement, it can form a ration in which little or no animal or marine protein is necessary. The digestibility coefficients for amino acids in soybean meal are greater than 90%, whereas for animal protein meals are much lower (Parsons, 1991). The high heat applied during the drying process of blood affects its haemoglobin content and makes it resistant to proteolytic enzymes. Such type of processing unexpectedly lowers its digestible protein content as well as the biological value. Similarly, in addition to other factors which affect the quality of fish meal, the salt content used during its processing is one of the main factors which limit its usefulness. The higher ash content of ration A as indicated by proximate analysis (table 3 & 4) as compared to ration B, C and D may also be one of the reasons for its poor performance. Significantly higher mortality observed in birds fed on commercial ration seems to have some sort of association with animal protein sources (fish meal, blood meal). As when these animal protein sources in commercial ration were replaced with SBM although the weight gain and FCR of the birds did not improve significantly. The percentage of mortality of birds reduced significantly. Normally the processing methods as well as the raw materials used for the preparation of fish meal, blood meal and meat meal under local conditions are not of standard nature and this may lead to a poor quality end product. The use of minimum number of properly processed standard quality feed ingredients is therefore suggested for the preparation of commercial formula rations to obtain the maximum output. Very recently Han et al. (1992) have demonstrated that chicks fed the amino acid fortified low protein corn-soybean meal based diet (16% CP) had growth performance similar to chicks fed the positive control diet (20% CP).

The results are in line with the earlier findings of Haq et al. (1986) who fed broiler chickens up to the age of 5 weeks on control diet containing 12% fish meal and 3 experimental diets containing

4, 8 and 12% fish meal and 3 experimental diets containing 4, 8 and 12% soybean meal replacing fish meal. They observed no significant differences among the groups in weight gain, feed intake and feed efficiency. Veltmann et al. (1986) reported that the nutritive value of commercially processed soybean meal should be assessed on the basis of chick biological tests. While comparing the biological value of fish meal and soybean meal Okan and Ogun (1986) concluded that the soybean meal supplemented with methionine can replace fish meal in strater ration for broilers.

Non-significant differences observed in the weight gain, feed conversion ratio, dressing percentage and mortality percentage of birds fed on rations C and D indicated that the inclusion of FFSB upto a level of 25% can efficiently replace SBM in broiler rations without any ill effect on their performance. These results are in line with the findings of Waldroup and Cotton (1974) who concluded from their study that fullfat soybean meal can be incorporated upto 25% level in broiler rations (mash form) without impairing their performance. Thomason (1986) reported the excellent response of broilers to rations containing fullfat soybean meal upto a level of 29%. Bougon et al. (1982) compared the performance of broiler chickens on 5 isocaloric diets containing maize-soybean oil-meal with 5% tallow (control) or including at the expense of oil meal about 8.5% extruded soybeans with 2.5% tallow or about 17% with no added fat. They reported that the performance of chickens was non-significant on all the diets. The inclusion of fullfat soybeans in broiler starter and finisher rations (mash) gave comparable performance to soybean meal when it was less than 20% of the diet (Horani, 1988). Fullfat soybean meal is an instant source of fat which provides not only highly digestible energy but also linoleic acid which is an essential fatty acid required for the poultry. Thus it is apparent that in places where the use of added fat in poultry rations is limited due to factors such as availability, costs, handling and equipment, fullfat soybean meal can be a great source of energy especially when higher energy feeds are desirable (Horani, 1988). Aletor et al. (1989) reported that chicks when given equiprotein diets with fish meal (FM) replaced by soybean meal (SBM) at 0, 20, 40, 60, 80 and 100% level did not show any significant effect on carcass characteristics.

The economic analysis of raising broilers on all these 4 rations was also carried out with input/output relationship. The results are presented in table 7. Significantly higher net profits were obtained for the groups fed on corn-soybean meal based rations. The birds fed on ration B although showed significantly less net profit values as compared to those fed on corn-soybean meal based rations, these were significantly higher than those fed on commercial ration (A). The lowest profit margins for group A fed on commercial ration may be correlated with its poor feed efficiency, lower weight gain and higher mortality percentage of birds. Although there were non-significant differences in the net profit values for rations C and D, the ration D containing FFSB showed slightly lower profit margins as compared to ration C that contained only SBM. The results are in line with the findings of Paulding et al. (1986) who reported that based on the price

TABLE 7. ECONOMIC ANALYSIS OF FEEDING COMMERCIAL AND CORN SOYBEAN MEAL BASED RATIONS TO BROILERS (IN PAK RUPEES)*

Parameters/Rations	A	B	C	D
Cost of feed	12639	12682	14615	15617
Cost of chicks	5586	5586	5586	5586
Cost of management	1250	1250	1250	1250
Total cost	19475	19518	21451	22453
Sale revenue	20443	22646	25724	26616
Net profit/loss	+968[a]	+3128[b]	+4273[c]	+4163[c]

[a,b,c] Mean values for net profit in the last row with different superscripts differ significantly $p < 0.05$.
* 1 PAK Rupee = 0.04 US$.

relationship existing during the time period of one study, fullfat soybeans deemed uneconomical as a replacement of soybean meal.

Overall these results indicated that the birds fed on corn-soybean meal based rations, gained significantly higher weights, showed better feed efficiency, gave higher dressing percentage with better carcass composition and net profits as compared to those fed on commercial ration. The replacement of animal protein sources in commercial ration with SBM (ration B) although did not show any significant differences in the performance of birds as compared to commercial ration a little improvement was visible indicating that SBM can be used as a good substitute of animal protein sources. Similarly the replacement of SBM with FFSB upto a level of 25% did not affect the broiler performance as compared to only SBM based ration. It may be concluded that SBM can substitute animal protein sources and the performance of broilers can significantly be improved with higher net profits when given only corn-soybean meal based rations as compared to multinutrient based commercial ration.

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