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## The Effects of Pelleted and Unpelleted All Mash Broiler Diets on Performance, Carcass Quality and Internal Organ Developments of Broiler Chickens

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### Abstract

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The performance, carcass traits and internal organ development of broiler chickens as influenced by dietary form (pellet or mash) were assessed using 180 straight run Ana 2000, (14 to 63 days of age). Soyabean meal (SBM) mash diet was used as a reference diet. Full fat soybean (FFSB) was the other mash diet. The pelleted diet was a commercial source. Results showed lack of significant ( $P > 0.05$ ) influence of diet form on performance traits in the starter phase SBM mash diet produced the least feed cost per kg gain. In the finisher phase, feed intake and weight gain were not influenced significantly ( $P > 0.05$ ) by diet form but feed to gain ratio was improved significantly ( $P < 0.05$ ) for the SBM mash diet. Feed cost per kg gain was least on the pelleted diet. The cumulative effect of diets showed lack of significant ( $P > 0.05$ ) effect on feed intake. Weight gain was least ( $P < 0.05$ ) for broilers fed FFSB diet. Broilers fed pelleted and SBM gained similar weights. Feed cost per kg gain was least on SBM mash diet. Relative values for New York dressed, dressed weights, and breast of birds fed FFSB mash were significantly ( $P < 0.01$ ) lower than SBM mash and pelleted diets. Sex had no influence on relative values except abdominal fat where females had significantly ( $P < 0.05$ ) more fat than males.

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**Key words:** Broiler chicken, performance, carcass trait, internal organs, sex, Pellet and mash

### Introduction

The high cost of feed component (65-75%) as a variable in poultry enterprise is well established. The high cost is blamed on limited availability of conventional feedstuffs which are also competed for by man. Efforts at finding alternative feedstuffs have turned out useful results and research is still going on in that

direction. Apart from the sources being investigated, it was widely accepted as a norm in Nigeria and probably elsewhere to offer finished poultry feeds in the mash form. Pelleted feeds were used on government farms for rabbits but not for poultry. It is only recently, within the last decade that commercial feed millers have started experimenting with selling out pelleted

feeds for poultry. It was accepted, at least, on economic grounds that mash diets were adequate for poultry. This is because, the pelleting component of the feed plant entails additional plant and operational costs which expected to increase the cost of finished feeds.

The studies in literature have indicated beneficial effects of pelleted diets on poultry performance. Robertson (1950), Hussar and Robblee (1962), Runnels *et al* (1976), and Deaton *et al* (1988) but findings are inconsistent. Alternative reports range from depressed effect of pelleted diets (Stewart and Upp 1951), to non-significant effect of the pellets as compared to mash form. (Fuller and Wilson 1974). It becomes more interesting when disintegration of pelleted feeds into mixed forms (mash, crumbles, pellets) during transportation, and handling (loading, offloading and serving into feeding troughs) are implicated as some of the causes of reduced pelleted effect on performance pelleted feeds have also shown to be less effective on broiler performance in high ambient temperature environment (Reece *et al* 1984<sup>ab</sup>, and Reece 1985). The temperature environment cited in the literature (26.7°C) is much lower than the prevailing ambient temperature in most parts of Nigeria. This therefore casts doubts on the economical use of pelleted feeds in this country, at least for broilers.

The universal use of pelleted feeds for broilers have been reported (Pesti *et al* 1983 and Reece *et al* 1984<sup>ab</sup>). The practice of feeding pelleted diets to broilers and other breeds of poultry in this country is a recent development.

There are signs that more commercial feed millers are turning to pelleting their feeds, however, the all time availability of the product is often a problem in many parts of the country. As such apart from price differential, poultry farmers are often faced with the problem of switching from pelleted feed to mash and vice versa due to lack of a particular form during the course of production. Farmers need to know the beneficial effects (if any) of the pelleted feed on performance to be able to choose the economical form of feed (mash or pellets) and plan ahead of a production cycle. The inconsistencies of *research findings about pelleting a diet on broiler performance and the influence the high ambient temperature environment of this country will have on pelleting feeds, in addition to the price differential between mash and pelleted feeds in commercial feed stores prompted the conduction of this study.*

### **Materials and Methods**

One hundred and eight (180) straight run Anak 2000 day old broiler chicks were purchased and brooded collectively for 14 days and assigned at random in a completely randomized design to nine (9) deep litter pens each of which measured 3.5 x 1.75m<sup>2</sup>. Brooding for 14 days before the start of the study was to minimize the hatchery and other sources of variations that could cause reduced performance and death which were independent of dietary treatments (Farrel *et al* 1973). Each pen was assigned 20 chicks and there were three replicate pens per treatment. Therefore each dietary treatment was assigned

to 60 chicks. The study was conducted in an open sided poultry house that was well constructed and roofed with asbestos roofing sheets. The weather condition was such that additional brooding source of heat was no longer necessary after the 14 day brooding period.

Three dietary treatments were used and comprised, a reference mash diet comprising of soyabean meal (SBM) and maize as basal ingredients. The other mash diet utilized toasted full fat soyabean (FFSB) diet, soyabeans is commonly cropped in the study area (Benue State) and the commonest method of processing the seeds for broiler diets is through toasting by use of frying pans. SBM was used as a reference mash diet because of its excellent processing quality – solvent extraction, and proven deactivation of anti-nutritional factors through urease test confirmation. The third diet was the pelleted commercial source. Assignment of both chicks and diets to pens was at random. Feed and water were provided *ad libitum*. The composition of the experimental diets is presented in table 1.

At the end of the feeding trial, 2 birds of each sex (4 birds per pen and 12 birds per diet), which had their weights close to the average of the pen, were selected for carcass evaluation. Each bird was identified by leg band number and fasted overnight. Weights of the selected birds were taken the next day before slaughter. Birds were sacrificed by severing the carotid arteries and jugular veins. The sacrificed birds were immersed in hot water (60°C) for 30 seconds to enhance easy removal of feathers. Defeathering

was carried out manually and evisceration performed. The gizzard with fat and abdominal fat were recovered and wrapped in duplicating paper already identified with the diet number and sex. The wrapped material was then sealed in small polythene bag and packed in ice. Each carcass was weighed and refrigerated. After the operations, the polythene bags were stored in deep freezer overnight to cause the oily fat to be frozen and this minimized loss in weight of the oily fat. The frozen gizzard fat was recovered with the aid of a small sharp table knife. Recovered fats (abdominal and gizzard) were weighed using digital weighing balance of “Mettler” model. Ready to cook carcass parts and visceral organ weights were also taken with the aid of this sensitive balance. Data collected were subjected to analysis of variance and significant means were separated using Duncan’s Multiple Range Test and ‘t’ Test was used to show the sex effect as outline by Steel and Torrie (1980).

## **Results and Discussion**

The effect of pelleted and mash diets on performance traits of broilers chicken is presented in table 2.

### *Starter Phase:*

The performance traits (feed intake, weight gain and feed to gain ratio) were not significantly ( $P>0.05$ ) affected by the dietary forms (pellets or mash). There was a slight improvement (12.04%) for intake of pelleted diet over the SBM mash diet. The FFSB mash diet had highest

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Table 1: The Composition of Experimental diets

Feed Ingredients	Diets			Diets %/o	Diets		
	1 SBM	2 FFSB	3 Pellets		1 SBM	2 FFSB	3 Pellets
Soybean Meal (SBM)	35.00	-	-	30.00	-	-	-
Full fat Soyabeans (FFSB)	-	38.00	-	-	35.00	-	-
Palm Kernel meal	10.00	10.00	-	10.00	10.00	-	-
Maize	47.75	44.75	-	49.85	44.85	-	-
Palm Oil (Red)	-	-	-	1.00	1.00	-	-
Cassava root meal	-	-	-	2.00	2.00	-	-
Rice offal	2.00	2.00	-	2.00	2.00	-	-
Bone meal	4.30	4.30	-	4.30	4.30	-	-
*Premix	0.25	0.25	-	0.25	0.25	-	-
Salt	0.30	0.30	-	0.30	0.30	-	-
Methionine	0.20	0.20	-	0.15	0.15	-	-
Lysine	0.20	0.20	-	0.15	0.15	-	-
<b>Calculated analysis</b>	<b>100.00</b>	<b>100.00</b>	<b>-</b>	<b>100.00</b>	<b>100.00</b>	<b>-</b>	<b>-</b>
Crude Protein (%)	21.00	21.18	-	19.25	19.31	-	-
Energy (Kcal/kg ME)	2800	2900	-	2900	2925	-	-
Calcium (%)	1.200	1.200	-	1.200	1.200	-	-
Phosphorus (total %)	0.90	0.90	-	0.90	0.90	-	-
Methionine + Cystine (%)	0.80	0.80	-	0.70	0.70	-	-
Lysine (%)	1.20	1.20	-	1.00	1.00	-	-
<b>Determined Analysis (DM basis)</b>							
Crude Protein (%)	21.50	21.25	21.00	20.13	19.85	19.00	19.00
Ether Extract (%)	3.25	7.65	8.50	4.71	7.15	8.00	8.00
Crude Fibre (%)	3.95	4.63	5.00	4.36	4.95	5.40	5.40
Calcium (%)	1.15	1.25	1.20	1.21	1.18	1.20	1.20
Phosphorus (total %)	1.05	0.92	0.45 (avail)	0.85	0.79	0.41 (avail)	0.41 (avail)

\*Premix (OPTIMIX) supplied the following additional nutrients per kg of diet: Vits - A= 10,000 IU; D<sub>3</sub> = 200 IU; E = 10 IU; K = 2mg; B<sub>1</sub> = 1.5mg; B<sub>2</sub> = 4mg; B<sub>6</sub> = 15mg; B<sub>12</sub> = 0.01mg; Pantothenic acid = 5mg; Folic acid 0.5mg; Biotin = 0.02mg; Minerals: chloride = 0.2mg; Mn = 0.8mg; Zn = 0.05mg; Fe = 0.02mg; Cu = 0.005mg; Se = 0.2mg; Co = 0.2mg.

Table 2: The Effect of Pellet and Mash Diets on Performance Traits of Broiler Chickens

Performance Traits	Diets		SEM
	Pellets	Mash SBM	
<b>Starter Phase (14 – 35 days of age)</b>			
Feed intake g/bird/day	99	87	5.82
Weight gain g/bird/day	39	38	2.08
Feed: gain	2.54	2.28	0.21
*Feed cost/kg (feed) $\text{N}$	48.00	29.00	-
*Feed cost/kg (gain) $\text{N}$	121.92	111.72	-
<b>Finisher phase (35-63 day of age)</b>			
Feed intake g/bird/day	151	129	7.63
Weight gain g/bird/day	57	51	4.29
Feed: gain	2.65 <sup>ab</sup>	2.52 <sup>b</sup>	0.12
*Feed cost/kg (feed) $\text{N}$	44.00	47.42	--
*Feed cost/kg (gain) $\text{N}$	116.6	119.50	-
<b>Cumulative (14-63 days of age)</b>			
Feed intake g/bird/day	126	109	4.72
Weight gain/bird/day	.48 <sup>a</sup>	.45 <sup>a</sup>	2.75
Feed: gain	2.63 <sup>a</sup>	2.42 <sup>a</sup>	0.14
*Feed cost/kg feed $\text{N}$	46.00	48.21	-
*Feed cost/kg gain $\text{N}$	119.26	116.67	-
*Mortality Rate (%)	8.33	8.33	-

ab, Means within a row with different superscripts differ significantly (P<0.05).  
 SEM = Standard Error of Means  
 \* = Calculated values

intake value. This value was 14.94% more than the reference mash diet and 2.04% more than the pelleted form. This higher intake mean value of the FFSB mash was attributed to feed wastage rather than total consumption. Chicks were observed to scratch and select this feed more than the other two diets. Method of processing the full fat soyabean (toasting) was suspected to have caused the feed wasting effect. Perry (1975) stated that raw soyabean was bitter and animals did not like the bitter taste, and that moist heat treatment is more effective than dry heat in deactivation of anti-nutritional factors in raw soyabean. Weight gain was improved by 2.6% for the pelleted diet over that of SBM mash diet. The FFSB mash group gained 18.42% less weight than the SBM mash diet, and 25.8% less weight than the pelleted diet group. The presumed partial deactivation of anti-nutritional factors (especially trypsin inhibitors and agglutinins) in the FFSB were suspected to have caused the marginal and non-significant reduction in weight gain of the FFSB mash diet. Efficiency of feed conversion was not significant ( $P>0.05$ ) on all diets. However, the pelleted diet was poorer (11.4%) than the SBM mash diet while the FFSB mash was poorest (40.35%) when compared to the SBM mash diet. Feed cost per kilogram diet was lowest with the FFB mash but the poor efficiency of feed conversion value of this diet caused the cost per kilogram gain of same diet to be at par with the pelleted diet while the SBM mash cost less (8.84%) than these other two diets.

*Finisher Phase:*

Feed intake in the finisher phase was least numerically from the FFSB mash diet to the

pelleted diet that had the highest value. The non-significant improvement (16%) of pelleted diet over that SBM mash was higher than the 2.32% value of the SBM mash over the FFSB mash. The marginal decrease in feed intake of the mash diets was believed to be due in part to diet form. Birds that were fed the mash form of SBM diet were more efficient in converting feed to body weight and this improvement was 11.76% better than the group fed the pelleted feed, and 27.45% better than the group fed the FFSB mash. The difference between the two mash forms (SBM and FFSB) was significant ( $P<0.05$ ). However, the difference between SBM mash and pelleted feed was not significant ( $P>0.05$ ). The efficiency of feed conversion of SBM diet was slightly improved numerically when compared to the pelleted diet (by 5.15%), but was significantly ( $P<0.05$ ) better than the FFSB mash diet (by 28.57%).

Cumulatively, the total feed intake of birds fed all diets were not significantly ( $P>0.05$ ) different, but numerical differences showed that birds consumed pelleted feed (14.81%), and FFSB mash (4.62%) more than the SBM diet. Weight gain of birds fed FFSB mash was significantly ( $P<0.05$ ) lower than the other dietary treatment groups. The local method of toasting soyabean (usually employed by small scale poultry farmers who compound feed "on farm") apparently does not distribute heat evenly throughout the seed. Thus, some seeds or part appear charred while others appear untoasted. Coon, *et al* (1990) reported the presence of substantial amounts of oligosaccharides in SBM

which Hurrell (1990) and Parson *et al* (1992) blamed for reacting with lysine in the SBM resulting in the formation of Advanced Maillard reaction products which render lysine unavailable for protein synthesis (Capenter 1973). The apparent uneven distribution of heat throughout the seeds during the toasting process meant that some seeds or parts still contained trypsin inhibitors which interfered with protein digestion of the toasted FFSB mash. Moreover, Sibbald (1980) reported that the True Metabolizable Energy content of SBM was reduced by over heating. All these factors presumably played a role in reducing the weight gain of birds fed the FFSB mash diet. The feed conversion ratio of pelleted and SBM mash diets were significantly ( $P < 0.05$ ) better than the FFSB mash diet. Feed wastage and improper metabolism of this diet accounted for the poor result obtained. Although feed cost per kilogram of diet was highest on the SBM mash and least on the FFSB mash, the poor feed conversion ratio of FFSB mash caused the feed cost per kilogram weight gain to become highest among the three diets.

Preference for pelleted diets over mash by birds is well documented, O'Neil (1964), Hussar and Robblee (1962), Pesti *et al* (1984), Reece *et al* (1984<sup>b</sup>), Reece *et al* (1985), and Deaton *et al* (1988). This was not demonstrated in this study. This is believed to be due in part, to the disintegration of the pellets into mixed forms, crumbles, pellets and mash, (Reece *et al* 1984<sup>b</sup>), which reduced the effective prehension, the pelleted diets are known for (Alfred *et al* 1957).

Report indicates that chicks fed pelleted diet consumed 15% more feed than the group that was fed the same diet in mash form (Hussrand and Robblee 1962). The chicks in this study consumed 12.64% more feed in pelleted form than the SBM mash diet. For the entire period of the study, feed intake of pelleted diet group was 14.8% greater than that of the SBM mash. The improvement in feed intake of the group fed pelleted diet was not significantly different from the mash forms. Although the manufacturer of the pelleted diet used in this study lists animal and vegetable protein among other feed ingredients as part of the formulation and indeed buys large quantities of soyabeans produced in the study area and other neighboring states, no deliberate effort was made to find out the actual formula used for the diet in the study because feed millers are not likely to release their formulae. Attempts were however made to balance the mash diets to obtain total percentage values similar to the determined analysis of nutrients supplied on the feed bag.

Weight gain improved by 2.6%, 11.76% and 6.6% for the group fed pelleted diet during the starter, finisher and cumulative periods respectively when compared to the SBM mash. Weight gain of birds that were fed the FFSB mash diet was consistently lowest during the two phases of the study and this resulted in the cumulative weight of birds fed this diet being least among the three diets. The final body weight of all groups fed the three diets attained weight of 1.80kg or more desirous of finished broilers in 63 days of age. Pelleting a ration is

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said to improve efficiency of feed conversion (Sell and Thomas, 1965). This effect was not demonstrated in this study. The lack of pelleting effect on the efficiency of feed conversion may be due in part to the high ambient temperature environment where day light temperatures sometimes reached 40°C. Reece *et al* (1984<sup>a</sup>), Reece *et al* (1984<sup>b</sup>), Reece *et al* (1985) showed that pelleting same feed from the mash form, improved feed conversion in cooler temperature environment (21°C) but the improvement was not significant in warm (26.7°C) temperature environment.

### *Carcass Traits:*

The results of the effect of pelleted and mash diets on the relative carcass traits of broilers are presented in table 3. Carcass yield, as measured by the percentage New York dress (empty carcass with head and shank) showed no variations between the pelleted and SBM mash diets. These two diets were significantly ( $P < 0.01$ ) higher than the FFSB mash diet. Relative values for breast muscle development were higher for the pelleted and SBM mash diets than the FFSB mash. This indicated that the demand for utilizable nutrients for breast muscle development was more than the other organs, as such, the FFSB mash diet was unable to supply the needed nutrients in sufficient amount and therefore produced significantly ( $P < 0.01$ ) lower relative value. The legs showed lack of significant effect of diet form, indicating that leg muscle development did not have as high a demand for utilizable nutrient as breast muscle; hence relative values evened out on all diets. The

Table 3: The Effect of Pellet and Mash Diets on Carcass Traits of Broiler Chickens (63 days of age) relative values (%)

Carcass Traits	Pellets	Diets Form		SEM	Sign. Level
		Mash SBM	Mash FFSB		
New York Dressed	79 <sup>a</sup>	78 <sup>a</sup>	74 <sup>b</sup>	0.89	***
Dressed weight	73 <sup>a</sup>	73 <sup>a</sup>	67 <sup>b</sup>	0.76	***
Breast weight	24 <sup>a</sup>	23 <sup>a</sup>	19.2 <sup>b</sup>	0.64	***
Legs (Thigh + drum stick)	23	23	22.0	0.45	-
Thigh	13	13	12	0.32	-
Drum stick	10.3	9.67	9.93	0.23	-
Gizzard + Proventriculus	2.3	2.7	3.1	0.18	-
Liver	2.3	1.6 <sup>b</sup>	2.0 <sup>ab</sup>	0.09	***
Spleen	0.11	0.10	0.16	0.01	-
Pancreas	0.22	0.21	0.26	0.02	-
Abdominal fat	1.40	2.39	2.06	0.33	-

a,b. Means within a row with different superscripts differ significantly ( $P < 0.05$ ), SEM = Standard Error of Means

**Table 4: The Effect of Sex on Carcass Traits of Broilers reared to 63 days of age.**

Carcass Traits	Sex		SED
	Male	Female	
New York Dressed (%)	78	76	0.91
Dressed weight (%)	77	71	2.51
Breast weight (%)	21.34	22.69	0.70
Legs (Thigh + drum stick) (%)	22.89	22.02	0.57
Thigh (%)	12.60	12.40	0.20
Drum Stick (%)	10.31	9.62	0.48
Gizzard + Proventriculus (%)	2.28	2.68	0.25
Liver (%)	2.01	1.83	0.14
Spleen (%)	0.13	0.12	0.05
Pancreas (%)	0.21	0.25	0.02
Abdominal fat (%)	1.45 <sup>a</sup>	2.45 <sup>b</sup>	0.12

a,b. Means within row with different superscripts differ significantly (P<0.05).  
 SED = Standard Error of the difference.

relative values for internal organs were not significantly different among the diets except the liver values. Relative values for abdominal fat were not significantly affected by the quantity of feed consumed per diet and dietary form. Values were within the suggested level (2.0%) for acceptable broiler carcasses (Anonymous 1983).

Carcasses were assessed on the basis of sex. The results for relative values are presented in table 4. No significant differences existed between the males and females on all carcass traits except abdominal fat, which was significantly heavier for female than male broilers. It has been shown that, female broilers deposit more fat than males (Lipstein *et al* 1975 and Tion 1983).

**Conclusion**

The study indicates that feeding balanced broilers diet in the mash form will convey similar

beneficial effect of the pelleted diet on performance in high ambient temperature environment prevailing in this country. The cost of mash feed is likely to be cheaper than the pelleted feed and this will give better economic returns on investment when mash diets are used. The use of FFSB for broiler rearing is not as beneficial as using SBM or pelleted diets as shown by high cost of the diet per kilogram gain, and significantly (P<0.01) lower relative mean values for principal component of broiler carcass-breast muscle.

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