

Comparison of some performance characteristics in broiler chickens raised on deep litter and fed either pelleted or mash feed of similar nutritional value

F. N. A. ODOI, V. NORGBEY, K. BAAH-FRIMPONG, P. OBU & V. AGBELENGOR

Department of Animal Science, School of Agriculture, University of Cape Coast, Cape Coast, Ghana

ABSTRACT

Two hundred hybrid, broiler day-old chicks were raised on deep litter and fed rations of similar nutrient composition either in the form of mash or pellets. Over a period of 47 days, the performance of birds in the two treatments (four pen replicates of 25 birds each) was compared in a completely randomized design experiment. The birds were transferred to a rearing house after 4 weeks of brooding and raised on deep litter (wood shavings) with floor spacing of 3.1m² for each pen replicate of 25 birds. Mash feed was prepared by milling the previously pelleted feed. Five birds in each replicate were randomly tagged for weekly weighing and carcass evaluation purposes at the end of the trial. Feed and water were offered *ad libitum*, and all routine health schedules recommended for broiler birds in Ghana were followed. Performance (mean per bird) was significantly better ($P < 0.05$) for pellet-fed than for mash-fed birds. These were daily weight gain (42 and 38 g), total feed intake (4.3 and 4.2 kg), live weight at slaughter (2.0 and 1.8 kg), and dressed weight (1.55 and 1.40 kg). However, daily water consumption (204 and 182 ml), feed conversion ratio (2.1 and 2.3), and gizzard weight (49 and 40 g) were not significantly different ($P > 0.05$). The cost of feeding birds and revenue from sales were higher for birds raised on pellets than for those raised on mash feed. The higher revenue was the result of faster growth rates, better feed conversion efficiency, and higher dressing percentage. Results of this study suggest that farmers raising broiler birds in Ghana should be encouraged to consider the use of pelleted rather than mash feed, for more efficient production and increased profits.

RÉSUMÉ

ODOI, F. N. A., NORGBEY, V., BAAH-FRIMPONG, K., OBU, P. & AGBELENGOR, V.: *Comparaison de quelques caractéristiques de rendement en poulets de chair élevés sur la litière profonde et nourri d'aliment gros granulé ou pâtee de valeur alimentaire semblable*. Deux cents hybrides poussins de chair âgés d'un jour étaient élevés sur la litière profonde et nourri de rations de composition nutritive semblable qui étaient offertes sous forme de pâtées ou plomb. Pendant 47 jours, le rendement des colailles dans les deux traitements (quatre répliques d'enclos de 25 volailles par chacun) étaient comparés, dans une expérience de dessin complètement choisis au hasard. Les volailles étaient transférées à la loge d'élevage après quatre semaines de couvain, et élevées sur la litière profonde (copeaux de bois), avec espacement par terre de 3.1 m² pour chaque réplique d'enclos de 25 volailles. Aliment de pâtee était obtenu par le moulage d'aliment préalablement gros granulé. Cinq volailles en chaque réplique étaient marquées au hasard pour le pesage hebdomadaire et les buts d'évaluation de carcasse, à la fin de l'essai. L'aliment et l'eau étaient offerts *ad libitum* et tous programmes de routine sanitaire recommandés pour les poulets de chair au Ghana étaient suivis. Rendement (moyen par volaille) étaient considérablement mieux ($P < 0.05$) pour les volailles nourries de macrogranulé que pour celles nourries de pâtee. Ces étaient respectivement: gain de poids quotidien (42 et 38 g); total d'aliment consommé (4.3 et 4.2 kg); poids à l'abattage (2.0 et 1.8 kg) et poids de la préparée (1.55 et 1.40 kg). Toutefois, la consommation quotidienne d'eau (204 et 182 ml); proportion de conversion d'aliment (2.1 et 2.3) et poids de gésier (49 et 40 g) n'étaient pas considérablement différents ($P > 0.05$). Le coût d'alimentation des volailles et le revenu de la vente étaient plus élevés pour les volailles nourries de macrogranulé que pour celles élevées d'aliment pâtee. Les revenus plus élevés étaient le résultat des proportions de croissance plus rapides, une meilleure conversion efficace d'aliment et un pourcentage de

Research and development note. Received 4 Apr 01; revised 11 Mar 03.

Introduction

Rapid increases in population, urbanisation, and standard of living in many developing countries, including Ghana, have resulted in a higher demand for meat protein. The poultry industry has played a prominent role in attempts to meet this increased demand. However, the poultry industry in Ghana has performed below its potential, mainly as a result of poor nutrition and management. The high cost and unreliable supply of feed ingredients on the local market has impacted negatively on growth of the industry. Over the recent years, the problem of feed supply has been tackled mainly through increasing use of "non-conventional feed ingredients". An aspect of management that has not received enough attention, but is potentially costly to the farmer, is the inefficient use of feed on the farm. The form in which feed is presented to birds, especially its density or texture, influences how much of it is wasted (Kesse, 1992). Feed offered in the form of mash, because of its dusty nature, can be lost with more ease through the action of wind or when spilled by birds or attendants, than higher density forms such as pellets or crumbs. Feed wasted invariably adds to the cost of production.

Feed processing methods such as pelleting or crumbing reduce dustiness and spillage, prevent selection, destroy anti-nutritional factors during sterilisation, and generally improve texture, flavour and taste. For example, intake of broilers was 10 per cent higher on crumb or pellet feeds than on mash (Bolten & Blair, 1997). Such birds that eat more feed may be expected to grow faster than others on mash. Norgbey (1999) had broilers in battery cages recording higher weight gain, lower feed conversion ratio, and higher dressing percentage when fed on pellets compared to mash of comparable nutrient content.

préparation plus élevé. Les résultats de l'étude suggèrent que les éleveurs de volailles de chair au Ghana devraient être encouragés de considérer l'utilisation d'aliment gros granulé plutôt que la pâtée, pour une production plus efficace et des bénéfices augmentés.

Pelleted feed for poultry have been available on the Ghanaian market for some years now, but have not been well patronised mainly because they cost more than the mash forms. The local poultry industry now remains in the hands of small-scale farmers who raise birds primarily on mash-type feed and on the deep litter system.

Therefore, this study aimed to compare the performance and cost of producing broiler chickens when offered pellet or mash-type feed, of similar nutritional value, under the deep litter system of management.

Materials and methods

The experiment was conducted at the Teaching and Research Farm of the School of Agriculture, University of Cape Coast, Cape Coast, Ghana, over 47 days, between September and November 1999.

Experimental design, feeding, and management

Two hundred hybrid broiler day-old chicks, hatched locally from imported eggs, were used in a completely randomised design experiment. For the two treatments, feed was offered either in the form of pellets or mash. Each treatment had four replicates of 25 birds each (mean weight of day-old chicks was 44 g).

The chicks were brooded in 8-replicate compartments on a litter of wood shavings at a floor spacing of 0.007 m² per chick for 28 days at between 30 and 35 °C. At the end of the 7th day (Week 1), five chicks (representing 20 per cent of total number) were picked randomly from each replicate and wing-tagged as sample birds in order to monitor growth performance through a weekly weighing routine. At the end of 28 days (Week 4), birds were transferred, in their replicate groups, to a well-ventilated rearing house with eight pens

(each with floor space of 3.1m²). A continuous lighting regime was provided.

All chicks were offered the same broiler starter ration for the 28-day brooding period, and subsequently changed over to the same finisher ration (Table 1). All feed used were procured from a commercial miller, originally in the form of pellets. Mash feed was then prepared by milling previously pelleted feed into a commercial mash texture. This was to ensure uniformity in composition and nutrient content. Feed and water were offered *ad libitum*. Birds were fed and watered twice daily (morning and evening) and left-over feed weighed out the next morning. The difference between feed offered and feed left over next morning was recorded as intake per pen for the day.

Determination of weight gain, feed conversion ratio, and dressing percentage

Tagged birds in each treatment and replicate pen were individually weighed weekly, to record any changes in weight over the period. Feed conversion efficiency was estimated for each of the treatments.

Tagged birds were slaughtered at the end of 47 days. The procedures outlined by Kesse (1992) were used to dress the birds, and dressing percentage was derived. Gizzards from each bird in each treatment were severed and weighed, separately.

Chemical and statistical analysis

Data on parameters measured for the treatment groups were subjected to analysis of variance (ANOVA). Differences between treatment means were determined by the Duncan's Multiple Range Test (Steele & Torrie, 1998).

Results and discussion

Nutritional composition of feeds

Table 1 shows the nutritional composition of the commercial compound pellet feeds used for the trial. Energy and crude protein levels in the starter and finisher rations were in line with the NRC

TABLE 1

Composition* of Broiler Starter and Finisher Pellet Feeds Used

Nutrient	Starter feed	Finisher feed
Protein	20.5%	18.5%
Energy	2850 cal/kg	2850 cal/kg
Fat	5%	5%
Fibre	5%	5%
Calcium	1%	1%
Available phosphorus	0.45%	0.44%

* Values obtained from manufacturer (Ghana Agro Foods Company, GAFCO). Proportions of individual feed ingredients were not provided on manufacturer's label.

(1975) recommendations for broiler chickens. Both treatment rations (pellet and mash) had similar nutritional levels.

Feed and water intake

Fig. 1 shows daily feed intake on a per weekly basis. Birds on pellet feed generally had higher intake compared with those on mash. Mean daily intake over the production period of 47 days was 2.3 per cent higher for birds on pellets compared to those on mash (Table 2), and was significant ($P < 0.05$) between treatments, over Weeks 5 to 7. Birds on pellets did not seemingly eat more than those on mash (Fig. 1) over the first 4 weeks,

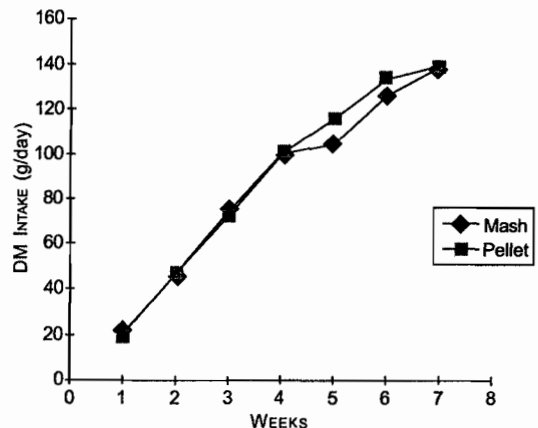


Fig. 1. Mean feed intake (g/bird/day) from pellet and mash feeds over the production period.

TABLE 2

Mean values for parameters measured over production period

	Mash	Pellet	SE	Difference
Total feed intake (kg/bird)	4.2	4.3	0.1	NS
Water intake (cm ³ /bird/day)	182	240	15.5	NS
Ratio of water drunk to feed consumed	1.9	2.2	0.0	NS
Initial weight (g/chick)	40	40	0.0	NS
Daily weight gain (g/bird)	38	42	2.2	*
Final weight (kg/bird)	1.8	2.0	0.1	*
Feed conversion ratio (g/g)	2.3	2.1	0.1	NS
Dressed weight (kg)	1.40	1.55	0.1	*
Dressing percentage (%)	76.8	79.1	1.5	NS
Gizzard weight (g)	40	49	6.7	NS
Cost of production per bird (¢)	7660	7935	50	*
Mortality (%)	1	2	-	-

* Difference between treatment means were significant at the 5 % level ($P < 0.05$)

probably because at such a young age and size, chicks might have had some difficulty in picking up the bigger-sized pellets. It has been recommended that at the brooding stage, chicks should be fed mash or crumble feed, rather than large-sized pelleted feeds (North & Bell, 1990).

Fig. 2 shows the daily water intake per bird (cm³) on a weekly basis. Birds that ate pellet feed generally drank more water than birds on mash. These differences were significant ($P < 0.05$)

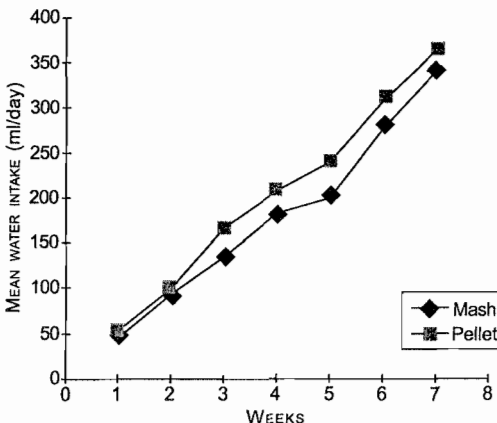


Fig. 2. Mean water intake (ml/bird/day) on pellet and mash feed over 47 days production period.

between Weeks 3 and 7. It has been suggested that birds on pelleted feed eat faster than those on mash (Bongon, Belaine & Launary, 1998), and therefore, tend to have more time available after eating to drink and idle. The ratio of water to feed intake was 2.2 (on pellets) and 1.9 (on mash). These values were higher than the 1.6 reported by Saxena (1995) for broilers under temperate conditions.

It had been expected that birds on dry mash would consume more water (North & Bell, 1990) than those on pellets. However, birds on pellets drank 11 per cent more water daily than birds on mash. This higher water intake probably directly reflects the higher DM intake over that period.

Live weight gain and feed conversion ratio

Fig. 3 shows live weight gain in birds on pellets and mash. Weight gains were significantly higher ($P < 0.05$) in pellet-fed birds than in birds on mash throughout the production period. The pattern of weight gain shown did not follow a trend similar to that observed for feed intake (Fig. 1), especially over Weeks 1-4. The litter of birds on mash was more soiled with feed than that of birds on pellets. Feed intake credited to birds on mash during

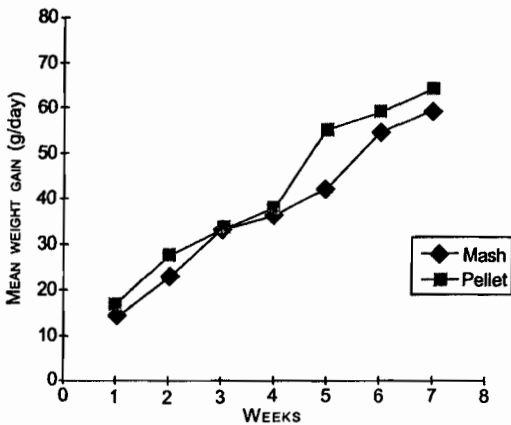


Fig. 3. Mean weight gain (g/bird/day) on pellet/mash over production period.

Weeks 1-4 may be partly attributed to wastage. This was because weight gained by birds on mash did not reflect higher feed intake during this period.

Pelleting of feed generally improves bird performance. Weight gains were higher ($P<0.05$) for pellet-fed birds throughout the experimental period.

The trend observed for weight gain (Fig. 3) showed that values were highest in Week 5 for pellet-fed birds and in Week 6 for mash-fed birds. Farmers that are able to finish broiler birds at 1.5-2.0 kg weight by 5-6 weeks of age will reduce the period birds stay on the farm, cut down risks from losses, and probably increase profit margins. The trend in weight gain reflected the significantly higher ($P<0.05$) feed intake for birds on pellets from the 5th week onwards. The beak plays a major role in seizing food and determines speed of intake and quantity of food eaten by birds, especially with large particle-sized feed (Bongon *et al.*, 1998). Older birds with better-developed beaks picked up pellet feed with more ease than the younger ones.

The weights of birds at slaughter were 1.8 kg (mash) and 2.0 kg (pellets). These were within the target weight range of 1.7-2.2 kg recommended for 7-week-old broiler birds (Osteeven, 1993; GAFCO, 1995). The weight of birds on mash in this study was lower than that recorded by

Norgbey (1999) for broiler birds on similar feeds, but raised in battery cages. This is probably because of a higher level of wastage by birds fed mash on deep litter. Although the wastage on pellets might have been similar, these have the advantage of being picked up with more ease again from the litter because of their larger particle size. This suggests that farmers would probably save on feed cost by using pellets rather than mash feed through reduced wastage, particularly on deep litter.

Feed conversion ratio in this study (Table 2) was lower in pellet-fed birds (2.1) than in mash-fed birds (2.3). This observation agrees with the assertion that feed offered as pellets is generally used better than as mash (Ham, Morrison & Wilmot, 1960). Norgbey (1999) used similar feeds and recorded a conversion ratio for broiler birds of 2.0 (on pellets) and 2.1 (on mash) over a 7-week period. This observation also confirms the belief that feed conversion is poorer on deep litter than in battery cages. The higher growth response to pellets would seem to be largely due to the higher level of feed consumption.

Relative cost/revenue from birds on pellet or mash feeds

Table 3 shows the cost of feeding birds and

TABLE 3

Mean Cost/Revenue for Birds Raised on Mash or Pellet Feed

Parameter	Mash (¢)	Pellet (¢)
Cost of 25 kg bag of feed	24 550.00	36 190.00
Cost of feed consumed per bird	4 125.00	4 400.00
Cost of day-old chick	1 800.00	1 800.00
Cost of drugs and vaccines	795.00	795.00
Cost of labour producing a chick	940.00	940.00
Total cost of production per bird	7 660.00	7 935.00
Revenue from sale of a bird*	9 800.00	10 990.00

* Price of 1 kg broiler meat (dressed) = ¢7,000.00

* Extra revenue obtained from sale of a bird (pellet-fed over mash-fed) = ¢1,190.00

* Production costs considered only items listed in table above

revenue from the experimental broiler project. The analysis shows that an additional ₵275.00 was incurred per bird raised on pellets. The cost of feeding birds was about 54 per cent of the total cost of production (on mash) and 55 per cent (on pellets) over the 47 days. These values are lower than the 60 per cent reported by Kesse (1992) or the 70 per cent by Kekeocha (1984) for production periods of between 8 and 12 weeks. However, they are higher than the 50 per cent reported by Norgbey (1999) for broilers raised in battery cages. This may be due to a higher level of feed wastage generally evident under the deep litter system of production.

Mean dressed weight of birds was 1.55 kg on pellets and 1.40 kg on mash in this trial. Thus, for the extra cost of ₵275.00 spent on pelleted feed, an additional ₵1,190.00 was realised on each bird sold, thereby maximising income generated.

Summary of results

Table 2 summarises the production characteristics measured for birds raised on either pellet or mash feed. The mean dressing percentage of 79.1 (on pellets) was better than 76.8 (on mash). Both values were within the recommended target value of 78.9 per cent (North & Bell, 1990) for broilers of that age. Birds raised on mash appeared more uniformly and better feathered than birds on pellet feed. Elliot (1995) suggested that this could be due to a greater channelling of energy towards feathering than muscle build-up.

Poorly feathered birds tend to have higher metabolic rates (Bolten & Blair, 1997). This combines with about 30 per cent increase in productive energy as a result of pelleting (Williams, 1997) to promote higher dressing percentage in pellet-fed birds than in birds on mash. This is based on the assumption that such extra energy available to pellet-fed birds was channelled into the build-up of muscle. Feed intake is higher on pellets, irrespective of body energy requirements.

Gizzards severed from pellet-fed birds had a higher mean weight (49 g) than those from birds

on mash (40 g). Larger particle-sized feeds such as pellets exercise the gizzard in grinding more than smooth feeds such as mash (Bongon *et al.*, 1998), and usually result in increased weight and development of the gizzard.

Conclusion and recommendations

Feeding birds with pellets instead of the more conventional mash-type feed over the 47-day production period resulted in higher feed and water intake, higher slaughter weight, and higher dressing percentage (including a higher gizzard weight). The cost of feeding birds on pellets, although higher, also generated higher returns from sale of birds that reached market weight in a shorter period of time. Thus, it was still more profitable to raise broiler birds on the more expensive pelleted feed than on traditional mash which is popular with Ghanaian farmers.

The results of this study confirm earlier observations on broiler birds raised on similar feeds in battery cages (Norgbey, 1999). Farmers in Ghana are, thus, encouraged to consider the use of pelleted feeds for greater efficiency and profits.

It is recommended that feed manufacturers consider producing smaller particle-sized pellets, or crumbles, for use during the brooding phase of production when birds are small. Local manufacturers should also consider using more effective binders to stabilize pelleted feeds. Alternatively, pellets should be handled with greater care, through the distribution chain (i.e. from factory to sales' outlets), to reduce the high level of broken feed. This will help maintain the beneficial effects of pelletising feeds.

Acknowledgement

The authors wish to acknowledge the Ghana Agro Feeds Company (GAFCO) for donating all the pelletised broiler starter and finisher feeds used in this study.

REFERENCES

Bolten, W. & Blair, R. (1997) *Poultry nutrition*.

- Agricultural Research Council*, Poultry Research Centre. Edinburgh. 80 pp.
- Bongon, M., Belaine, L. S. & Launary, F.** (1998) Feeding factors that affect pullet growth. *Wld Poul.* **14** (5), 18-22.
- Elliot, M.** (1995) Factors affecting feathering. *Wld Poul. Misset* **12** (7), 12.
- Ghana Agro Foods Company (GAFCO)** (1995) *Technical Production Guide*. Accra, Ghana. pp. 1-8.
- Ham, D., Morrison, J. R. & Wilmot, E. D.** (1960) Feeding pattern of broilers on different feed forms. *Arkansas Agric. Expl. Stn Bull.* p. 631.
- Kekeocha, C. C.** (1984) *Pfizer poultry handbook*. Macmillan Publishing Corporation. p. 105.
- Kesse, A. G.** (1992) *Profitable poultry production*. Ghana Animal Science Association (Publishers). University Press, Kumasi, Ghana. pp. 30-45.
- Norgbey, V. A.** (1999) *Comparing the performance of broilers on either mash or pelleted feed* (B Sc Dissertation). School of Agriculture, University of Cape Coast, Ghana. pp. 24-27.
- North, M. O. & Bell, D. D.** (1990) *Commercial chicken production manual*, 4th edn. New York: Chapman and Hill. pp. 721-729.
- NRC** (1975) *Nutrient requirements of poultry*, 5th edn. Washington DC: National Academy Publishing Company.
- Osteeven, G. A.** (1993) *Raw materials for feedstuff for poultry*. Barneveld College, Netherlands. pp. 1-22.
- Saexena, H. C.** (1995) Water: the most critical nutrient for maximising production. *Wld Poul. Misset* **11**(7), 31.
- Steele, R. G. D. & Torrie, J. H.** (1998) *Principles and procedures of statistics - A biometrical approach*, 2nd edn. New York: Mac-Graw Hill Book Company.
- Williams, V. E. P.** (1997) Mechanical pressing to improve nutritive value and sterilise feed. *Wld Poul. Sci. J.* **53** (1), 42-43.