# RESPONSE OF WEANER PIGS TO DIFFERENT COMMERCIALLY AVAILABLE PIG FEEDS IN SOUTHWEST NIGERIA

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## ABSTRACT
***The study was carried out with the view to comparing performance of weaner pigs fed four commercially available feeds (CAF). Three of these feeds (CAF1; T1, CAF2; T2 and CAF3; T3) were in pellet form while the fourth was in mash form (CAF4; T4). Feed samples were analysed for proximate compositions. The nutritional compositions of the CAF3 and CAF4 were same. The feeds were grouped into four treatment; Treatment 1 (CAF1), treatment 2 (CAF2), treatment 3 (CAF3) and treatment 4 (CAF4). Thirty-six weaner pigs with an average initial body weight (BW) of 14.75±0.45 kg were randomly allotted to the four dietary treatments, based on BW and sex (nine replicates with one pig) were used for the biological evaluation. At early growing phase the feeds were redistributed based on animal performance at weaner phase to validate the main effect of the feeds on performance of the animal. At the end of weaner phase, significant (p<0.05) differences exist among the variables measured. The final body weight (Kg) ranged from 21.9 to 37.6 and pigs fed with CAF4 (T4) and CAF2 (T2) having the highest and lowest values respectively. The daily feed intakes were comparable among the treatments except for the pigs on (T2) with the lowest daily feed intake (0.68 Kg). The feed conversion ratio of the pigs fed on (T1), (T3) and (T4) were similar and better, compared to that of pigs fed on (T2) that was higher and worse. The study concluded that there was no influence of feed form on the performance of weaner pigs and one of the feeds were not suitable for weaner pig performance.***

**Keywords:** *pellet, mash, performance***,** *cost analysis*

## INTRODUCTION
Escalation of pig farming activity has led to development of commercial pig feeds. Feeds given to the livestock should meet their nutrient requirements as well as the health assurances for their supply and marketing (Gabbi *et al* 2011) and form of delivery to the animals must be suitable. According to Condé *et al* (2017), the quality of a product is its suitability for the use to which it is intended and this can be justified by lots of measures. These include but not limited to chemical and biological evaluation. Increase pig growth and better feed efficiency as a result of improve nutrient digestibility, reduce feed wastage and increase flow-ability has been reported to be associated with feed pelleting (Ball *et al* 2015). According to O'Meara et al (2020), dry or wet/dry feeding of a pelleted diet has been indicated to be the preferred feeding strategy to optimize feed efficiency. The authors also reported that feeding a pelleted diet from a dry or a wet/dry feeder improved feed conversion ratio in growing-finisher pigs compared with all other feed forms irrespective of the delivery methods. However, the advantage of pelletized feed in

improving feed efficiency is mystified by particle size. This is because the larger the particle size of meal turned into pellet, the greater the benefit from pelleting (Patience et al 2015). Therefore, producers should be aware that a further reduction in particle size associated with the pelleting of an already finely ground meal can increase the risk of stomach ulceration (De Jong et al 2016) with consequent reduction in performance of the animals. It was hypothesized that some of the emerging commercial pig feeds would not meet the nutrient requirements of pigs and that mash form of the feed would be better than the pellet form in term of performance of the animals.

**MATERIALS AND METHODS**

AK Research Farms located in Ibadan, Oyo state, Nigeria (N 07.43093, E 003.84910), was used for the experiment. The study was apportioned into three phases (0-4, 5-8 and 0-8 weeks) with a validation phase and lasted for a period of eight weeks. Four commercially available pig starter feeds (CAF1, CAF2, CAF3 and CAF4) were gotten from local market. These feeds were in two different forms (Pellet and Mash). Pellet form were CAF1 (T1), CAF2 (T2) and CAF3 (T3) while CAF4 (T4) was in mash form. The calculated analysis of the nutrients according to the label on each of the feed were presented in Table 1. Treatment (T) 1 (CAF1) contained 20.5 % crude protein (CP), 3359 Kcal/ Kg digestible energy and 5.69 % crude fibre. Treatment 2 (CAF2) contained 18.1% CP, 2543 Kcal/kg and 15.2 % crude fibre. Treatment 3 (CAF3) and treatment 4 (CAF4) contained the same nutrient composition; 18.6 % CP, 2992 Kcal/Kg digestible energy and 7.07 % crude fibre but CAF4 was in mash form. During the biological evaluation, the feeds (CAF1; T1, CAF2; T2, CAF3; T3 and CAF4; T4) were fed to the experimental pigs. Thirty-six weaned pigs with average initial live weight of 14.8±0.45 kg were randomly distributed according to body weight and sex to the four dietary treatments (CAF1, CAF2, CAF3 and CAF4) with nine replicates and one animal per replicate in a completely randomized design. Concrete Pens (234 cm × 216 cm) and drinkers (97 cm × 33 cm) with semi-automatic feeders were used for the feeding trial. To clarify any form of doubt regarding weaner growth response, the experiment was repeated for data validation with the same animals but feeds were re-assigned. The feeds were redistributed to the groups of the animals as follows; feeds fed to the groups of animals on T3 and T4 (better utilized

**Table 1: Calculated nutrients analysis of the label of each of the Feeds**

| Parameters | T1 | T2 | T3 | T4 |
|---|---|---|---|---|
| Dried Matter (%) | 89.50 | 89.00 | 90.20 | 90.20 |
| Crude protein (%) | 20.52 | 18.12 | 18.51 | 18.50 |
| ME (Kcal/Kg) | 3359 | 2543 | 2992 | 2992 |
| Crude fat (%) | 5.03 | 10.01 | 7.73 | 7.73 |
| Crude fibre (%) | 5.69 | 15.22 | 7.07 | 7.07 |
| Ash (%) | 3.84 | 5.98 | 4.92 | 4.92 |
| Calcium (%) | 1.12 | 1.68 | 1.01 | 1.01 |
| Phosphorus (%) | 0.79 | 0.86 | 0.72 | 0.72 |
| Methionine (%) | 0.53 | 0.47 | 0.39 | 0.39 |
| Lysine (%) | 1.07 | 0.80 | 1.12 | 1.12 |
| Lysine/Methionine (%) | 0.76 | 0.75 | 0.90 | 0.90 |

feeds) during weaner phase were fed to the groups of animals on T1 and T2 respectively during validation phase. Similarly, the feeds fed to the groups of animals on T1 and T2 (poorly utilized feeds) during weaner phase were re-assigned to the animals on T3 and T4 respectively during validation phase and the repeated experiment lasted four weeks. The experimental feeds and water were offered to the animals unrestrictedly throughout the experimental period**.** Daily routine and occasional management practices were duly observed. The feed samples were analyzed for proximate composition according to standard procedures of AOAC (2002). Data obtained were analyzed using one-way analysis of variance of SAS (2002) procedures and means were separated using Duncan Multiple Range Test.

**RESULTS**

Table 2 showed the analysed chemical composition of diets fed to weaned pigs. There were variations between the value indicated on each of the feed label and analysed value.

The performance indices of the weaner pigs fed on four different commercially available feeds (CAF) at the first phase of the experiment (0-4 weeks) are shown in Table 3. These feeds were classified into two groups based on forms; the pellet and mash. Variations existed in all the parameters across the treatments except for initial body weight and daily feed intake. These variations were significant ($p<0.05$) among the treatment groups. The final body weight of the pigs stretched from 19.4 to 25.3kg with pigs fed CAF2 (T2) and CAF4 (T4) having the lowest and the highest values respectively. This trend was the same for body weight gain and daily weight gain. The values for body weight gain and daily weight gain ranged from 3.94 to 10.5 kg and 0.14 to 0.38 kg respectively. The final body weight, body weight gain and daily weight gain of pigs fed CAF3 (T3) and CAF4 (T4) were similar and higher than those of pigs fed with CAF1 (T1) and CAF2 (T2). The daily feed intake of the pigs was not significantly ($p>0.05$) different from one another, however, pigs fed CAF4 (T4) had the highest daily feed intake (0.97kg) when compared with the pigs fed with other feeds. The worst feed conversion ratio (4.97) was observed with the pigs fed CAF2 (T2) while the pigs fed with CAF3 (T3) had the best feed conversion ratio (2.90).

During the second phase (5-8 weeks) of the experiment, the performance of the pigs (Table 4) followed similar pattern with that of the first phase (0-4 weeks). There were significant ($p<0.05$) differences among the performance

**Table 2: Analysed chemical compositions of the experimental diets**

| Parameters | CAF1 | CAF2 | CAF3 | CAF4 |
|---|---|---|---|---|
| Dry matter (%) | 90.71 | 90.32 | 90.70 | 90.61 |
| Crude protein (%) | 17.22 | 14.90 | 16.30 | 18.81 |
| Crude fibre (%) | 4.77 | 6.53 | 5.55 | 5.87 |
| Crude fat (%) | 3.82 | 3.62 | 3.74 | 3.77 |
| Ash (%) | 6.58 | 7.50 | 6.74 | 6.76 |
| NFE (%) | 58.33 | 57.81 | 58.31 | 55.43 |
| NDF (%) | 38.41 | 43.20 | 40.42 | 46.80 |
| ADF (%) | 17.62 | 21.51 | 19.22 | 22.91 |
| ADL (%) | 3.56 | 5.77 | 4.04 | 6.94 |
| Hemicellulose (%) | 20.90 | 21.71 | 21.11 | 23.82 |
| Cellulose (%) | 14.01 | 15.81 | 15.21 | 16.00 |
| Gross energy(kcal/kg) | 4240.05 | 4190.40 | 4230.00 | 4140.09 |

NFE - Nitrogen Free Extract, NDF- Neutral Detergent Fibre,
ADF- Acid Detergent Fibre, ADL- Acid Detergent Lignin, % - percent

indices across the treatments. The body weight gain and daily weight gain ranged from 4.80 to 15.1 Kg and 0.17 to 0.54kg. The pigs that were fed with CAF3 (T3) had the highest ($p<0.05$) body weight gain (15.1kg) and daily weight gain (0.54kg) but these values were comparable with that of pigs fed CAF4 (T4). Similar trend was detected in daily feed intake of the animals. The pigs with higher daily weight gain had corresponding higher daily feed intake (1.43kg) while animals with the least daily weight gain had the lowest daily feed intake (0.76kg). The feed conversion ratio stretched from 2.75 to 4.66 and the best was observed in pigs fed CAF3 (T3) while the worst was noticed in pigs with lowest daily feed intake and daily weight gain (T2).

The performance indices of the animals that the feeds were purposively re-assigned to during validation phase are presented in Table 5. The body weight gain stretched from 11.56 to 29.4 Kg. The daily weight gain also followed similar trend with body weight gain. The body weight gain of animals across the treatments followed similar pattern with that observed during weaner phase except for the animals on T3 that performed better during validation phase than when they were on T1 during weaner phase. Daily feed intake ranged from 1.44 to 1.99. Irrespec-

**Table 3: Performance of weaner pigs fed the experimental diets (0-4 weeks)**

| Parameters | T1 | T2 | T3 | T4 | SEM | *p* |
|---|---|---|---|---|---|---|
| Initial body weight (Kg) | 14.30 | 15.40 | 14.50 | 14.80 | 0.4251 | 0.8600 |
| Final body weight (Kg) | $21.50^{b}$ | $19.40^{c}$ | $23.50^{a}$ | $25.30^{a}$ | 0.5050 | <0.0001 |
| Body weight gain (Kg) | $7.16^{b}$ | $3.94^{c}$ | $8.99^{ab}$ | $10.50^{a}$ | 0.6621 | 0.0035 |
| Daily weight gain (Kg) | $0.26^{b}$ | $0.14^{c}$ | $0.32^{ab}$ | $0.38^{a}$ | 0.0237 | 0.0035 |
| Daily feed intake (Kg) | 0.81 | 0.70 | 0.86 | 0.97 | 0.0371 | 0.0983 |
| Feed conversion ratio | $3.44^{b}$ | $4.97^{a}$ | $2.90^{b}$ | $2.97^{b}$ | 0.2331 | 0.0100 |

*$^{abc}$ means with different superscripts across the rows are significantly different (P<0.05), SEM; standard error of mean*

**Table 4: Performance of weaner pigs fed the experimental diets (5-8 weeks)**

| Parameters | T1 | T2 | T3 | T4 | SEM | *p* |
|---|---|---|---|---|---|---|
| Initial body weight (Kg) | 19.40 | 17.10 | 22.20 | 23.90 | 1.0503 | 0.0933 |
| Final body weight (Kg) | $30.20^{b}$ | $21.90^{c}$ | $37.31^{a}$ | $37.61^{a}$ | 1.4202 | <.0001 |
| Body weight gain (Kg) | $10.70^{b}$ | $4.80^{c}$ | $15.11^{a}$ | $13.61^{a}$ | 0.8204 | <.0001 |
| Daily weight gain (Kg) | $0.38^{b}$ | $0.17^{c}$ | $0.54^{a}$ | $0.49^{a}$ | 0.0293 | <.0001 |
| Daily feed intake (Kg) | $1.15^{b}$ | $0.76^{c}$ | $1.43^{a}$ | $1.26^{ab}$ | 0.0554 | <.0001 |
| Feed conversion ratio | $3.55^{ab}$ | $4.66^{a}$ | $2.75^{b}$ | $2.79^{b}$ | 0.2450 | 0.0128 |

*$^{abc}$ means with different superscripts across the rows are significantly different (P<0.05), .SEM; standard error of mean*

**Table 5: Performance of the experimental animals during validation phase**

| Parameters | T1 | T2 | T3 | T4 | SEM | *p* |
|---|---|---|---|---|---|---|
| Initial weight (Kg) | 30.16$^{b}$ | 21.86$^{c}$ | 37.26$^{a}$ | 37.56$^{a}$ | 1.4202 | <.0001 |
| Final body weight (Kg) | 48.01$^{b}$ | 51.26$^{b}$ | 60.28$^{a}$ | 49.11$^{b}$ | 1.5450 | 0.0139 |
| Body weight gain (Kg) | 17.86$^{c}$ | 29.40$^{a}$ | 23.02$^{b}$ | 11.56$^{d}$ | 1.3847 | <.0001 |
| Daily weight gain (Kg) | 0.51$^{c}$ | 0.84$^{a}$ | 0.66$^{b}$ | 0.33$^{d}$ | 0.0396 | <.0001 |
| Daily feed intake (Kg) | 1.44$^{b}$ | 1.50$^{b}$ | 1.99$^{a}$ | 1.45$^{b}$ | 0.0512 | <.0001 |
| Feed conversion ratio | 2.93$^{b}$ | 1.89$^{c}$ | 3.10$^{b}$ | 4.68$^{a}$ | 0.2122 | <.0001 |

*$^{abc}$ means with different superscripts across the row are significantly (P<0.05) different.*
*SEM; standard error of mean, T1= CAF3, T2=CAF4, T3=CAF1, T4= CAF2*

tive of purposive redistribution of the feeds, the feed conversion ratios followed same trend with what was obtained during weaner phase. The feed that gave the best feed conversion ratio (2.75) during the weaner phase (T4) also gave best feed conversion ratio (1.89) during validation phase (T2).

The economic analysis of the pigs fed the commercially available feeds is shown in Table 6. There exists significant (P<0.05) variations among all the parameters assessed. The cost (USD) of a kilogram of all the feeds used ranged from \$0.23 to \$0.29. The total cost (USD) of feeding stretched from \$3477 to \$7012 with the pigs fed CAF3 (T3) having the highest total cost (USD) of feeding. The total cost of feeding pigs fed with CAF4 (mash) was comparable to that of pigs fed with CAF3 (pellet). The cost of feed per kilogram weight gain was highest (\$1.17/kg diet) (P<0.005) in pigs fed feed with high-fibre diet (CAF2) while the lowest value (\$0.77/kg diet) was observed in pigs fed CAF4 (mash) and this was better than that of pig fed CAF3 (pellet).

## DISCUSSION

In this study, four commercially available pig starter feeds with two clearly distinct forms (pellet and mash) were appraised using biological and chemical methods. The growth performance indices followed similar trend for all the phases. The labels on the bag presented the data of basic nutritional composition including dried matter (%), crude protein (%), crude fat (%), crude fibre (%), ash (%), calcium (%), phosphorus (%), methionine (%), lysine (%) and lysine/methionine as required by Nigerian legislation (NIAS, 2017). The crude protein used in this study was optimum as it was in line with National Research Council (NRC, 2012) recommendation. There was a discrepancy between the analysed protein content of the T3 and T4 despite being of the same chemical composition. This may be due to storage as the mash diet was

**Table 6: Economic analysis of the pigs fed commercially available starter feeds**

| Parameters | T1 | T2 | T3 | T4 | SEM | *p* |
|---|---|---|---|---|---|---|
| Cost of feed/kg diet (USD) | 0.29 | 0.23 | 0.28 | 0.28 | - | - |
| Total feed intake (Kg) | 53.5$^{b}$ | 38.7$^{c}$ | 64.4$^{a}$ | 61.3$^{a}$ | 1.83 | <.0001 |
| Total cost of feeding (USD) | 15.49$^{b}$ | 8.96$^{c}$ | 18.07$^{a}$ | 17.20$^{a}$ | 0.629 | <.0001 |
| Cost of feeding per day (USD) | 0.27$^{a}$ | 0.16$^{b}$ | 0.32$^{a}$ | 0.31$^{a}$ | 0.015 | <.0001 |
| Feed cost/kg weight gain (USD/Kg) | 1.04$^{a}$ | 1.17$^{a}$ | 0.91$^{b}$ | 0.77$^{c}$ | 0.033 | <.0001 |

*$^{abc}$ means with different superscripts across the row are significantly different (P<0.05),*
*SEM; standard error of means*

fresher than the pellet when comparing date of production for each of the feeds. The poor performance of the animals fed with CAF2 may be attributed to lower crude protein content of the diet, among other factors as showed by the result of the proximate analysis of the feeds.

The pigs fed with CAF3 (pellet) and CAF4 (mash) had similar performance in terms of final body weight, daily weight gain, daily feed intake and feed conversion ratio. This was because the nutrient compositions of these feeds (CAF3 and CAF4) were the same but offered to the animals in different forms. The performance of the pigs fed CAF3 and CAF4 was better than that of CAF1 despite the fact that CAF1 was a higher nutrient-dense diet compared with CAF3 and CAF4. It was also noticed that the level of acceptance of the feed (CAF1) by the animals was low compared to what was expected of that class of pig. It is against the norm for animals to perform better on low nutrient-dense diets than high nutrient-dense diets. What could have been responsible for this anomaly remains unclear. The poor performance of the pigs on CAF2 (T2) as compared with the other feeds was justifiable with the nutritional composition of the feed. The feed contained high level of crude fibre (15.17%) and low level of digestible energy (2543 Kcal/kg), which are inadequate for weaner pigs (NRC, 2012). The lower energy density was as a result of high fibre level in the feed. This is supposed to have increased the feed intake, as it is generally believed that animals eat more to satisfy their energy need but the reverse was the case. Probably, this commercial feed (CAF2) was unpleasant to the animals and this has led to a reduction in daily weight gain of the animals. This observation was in agreement with the earlier findings of Coble *et al*. (2018), who reported reduction in average daily weight gain of pigs fed high fibre diet compared to those fed low fibre diets. The reduction in daily feed intake of pigs fed low energy and high fibre feed (CAF2) seemed to contradict existing knowledge on the effect of feeding low energy diets to the animals. As part of the observation during the course of the experiment, the feed (CAF2) was not appealing to the animals and there was a low level of acceptance. This finding did not corroborate the earlier reports that animals eat more to compensate for lower energy density for high fibre diets (Graham *et al*. 2014; Asmus *et al*. 2014). It is possible that high-fibre with low bulk density could extend the gut capacity of the pigs and consequently increase feed intake, regardless of the diet types (Coble *et al*. 2018). It was however noteworthy in this study that whether feed was offered in pellet or mash form, the resultant effect would be the same. This was evident in the present study where the same feed was administered to the pigs in different forms (pellet and mash) and their daily weight gain, daily feed intake and feed conversion ratio were similar (CAF3; T3 and CAF4; T4). Comparison of pellet and mash forms with no significant difference in this study is inconsistent with the earlier report of Potter et al (2009) who found increased average daily gain in pigs fed pelletized feed when compared with those fed mash form. Again, the authors stated that pig fed with pelletized diet had improved feed to gain ratio and heavier market and carcass weights than pigs fed mash diets. However, the result of this study was in line with the findings of Myers et al (2013) who reported similar feed conversion ratio for pigs fed a meal and pelleted diet using wet/dry feeding. In contrast, the feed conversion ratio of the pigs fed mash diet (CAF4) was reduced by 15.4% when compared with those fed pelleted diet (CAF3) at the overall phase of the present study. This observation was in isolation from that made by Potter et al (2009) on improved feed to gain ratio of pigs fed pelletized diet as compared to those fed mash diet. Also, to further strengthen the superiority of CAF3 (Pellet) and CAF4 (mash) with the same nutritional composition, the economic analysis revealed that it would be cheaper to produce a kilogram live weight of pig using these two commercial feeds irrespective of the forms offered to the animals, than using CAF1 (T1) and CAF2 (T2). In terms of economical comparison, the use of mash feed was better than the pelletized feed. This inference was drawn from the result on feed cost per kilogram live weight. There was 15.3% reduction in cost of producing a kilogram live weight of pigs using feed in mash form compared with pelletized form. It should be noted that this estimation did not consider the cost of pelletizing the feed.

Sometimes, it is often said that variations observed in many of experimental results should not be totally ascribed to the effect of the testing materials, as it may be due to chances or genetics. In view of this, the feeds used in this experiment were intentionally re-assigned to different (but same experimental animals used in the study) groups of animals to confirm the earlier growth response (Table 4) within four weeks. The feeds that were better utilized during the weaner phase were re-assigned to the groups of animals with poorest performance (poorly utilized feeds) to ascertain growth-enhancing ability of the feeds at the grower phase. Therefore, the comparisons in terms of performance were made as follows; T1 vs T3, T2 vs T4, T3 vs T1, and T4 vs T2 respectively for weaner and grower phases. The performance of the animals on T1 during weaner phase was compared with the performance of animals on T3 during grower phase and so on. The growth response of the animals during grower phase (Table 5) followed same pattern with that of weaner phase. The trend in body weight gain not differing from the values obtained during the weaner phase. The daily weight gain also followed similar trend. The body weight gain of the animals followed similar pattern with that observed during the weaner phase, except for the animals on T3 that performed better during the grower phase than when they were on T1 during weaner phase. Daily feed intake was also in line with the values obtained during the weaner phase. Irrespective of the purposive redistribution of the feeds, the feed conversion ratios followed the same trend with what was obtained during the weaner phase. The feed that gave the best feed conversion ratio (2.75) during the weaner phase (T4) also gave best feed conversion ratio (1.89) during grower phase (T2). The performance during the verification phase reinforced the earlier report on the growth response during the weaner phase. With the results obtained at the revalidation phase, it could be said that there were no influence of genetic factor or variation due to chances on the performance of the animals observed during weaner phase, but the true reflection of the nutritive value of each feed.

## CONCLUSION AND RECOMMENDATIONS

It could be concluded that weaner pig feeds should be formulated with combination of 2992 Kcal/kg digestible energy, 18.55% crude protein and 7.07% crude fibre. Also, the ideal energy to protein ratio (E/P) for optimum performance of weaner pigs in tropics was 161:1 or at most 166:1. Therefore, for optimum performance of weaner pigs in tropics, commercially available feed 3 (CAF3) and CAF4 are thereby recommended. Again, pelletizing weaner pig feed may not be necessary considering the cost implication, since performance would be the same, irrespective of feed forms.

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