

# Combining abilities among four breeds of chicken for feed efficiency variation: a preliminary assessment for chicken improvement in Nigeria

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**Abstract** General and specific combining abilities for feed efficiency in 5,191 chicks from a combination of four breeds of chickens, (Anak Titan (A), Alpha (B), Giriraja (G), and normal indigenous (N) chickens) were examined by means of diallel analysis. The analysis revealed that Anak Titan had the highest general combining ability of  $0.07 \pm 0.00$  while the least was Alpha with a value of  $-0.09 \pm 0.00$ . The results of the specific combining abilities (SCA) reveal a high value of SCA in GN cross with a value of  $0.08 \pm 0.01$  while the least value was  $-0.12 \pm 0.01$  (AN cross). It is recommended that an improvement process for feed efficiency that involves all the breeds should be adapted using a reciprocal recurrent selection or modifications of it. Anak Titan will be a good sire line and the GN cross a good dam line to use in such an improvement program.

**Keywords** Diallel · Indigenous · Chicken · Feed efficiency

## Introduction

Genetic improvement of Nigerian chickens could be achieved by crossbreeding indigenous with exotic commercial chickens to take advantage of the productivity in the exotic and the hardiness in the indigenous birds, thereafter the selection would result in birds with better productivity, adaptability, and overall cost-effectiveness in a tropical

environment especially when hybrids with good combining abilities are generated (Adebambo et al. 2009). This research studies the general and specific combining abilities for feed efficiency of pure and crossbred meat type chickens produced from four parental populations—Giriraja (G), Anak Titan (A), Nigerian improved indigenous chicken, Alpha (B), and the local (N) as a preliminary research for breed improvement.

## Materials and methods

The experimental birds comprised 5,191 chicks produced from a combination of four breeds of chickens maintained at the poultry breeding unit of the University of Agriculture, Abeokuta, Nigeria, viz., 45 Anak Titans, Israeli-type commercial broiler (A); 58 Girirajas, Indian-type dual-purpose chicken (G); 75 Nigerian normal indigenous chicken (N); 61 Alpha, Nigerian-developed improved indigenous chicken for higher egg production (B) as diallel crosses generated over a 2-year period, 2006–2008. The birds were reared intensively in cages and fed ad libitum with all other management practices provided. The chicks were wing-tagged along sire lines and weighed using a 0.01-kg sensitive balance. The feed efficiency of each genotype was evaluated weekly on hatching batch basis. The general linear mixed model procedure of the Statistical Analysis System® program (SAS 1999) was used to determine age, sire, and dam genotype effects, expunge other nonsignificant interaction effects except sire by dam interactions and correct by covariant relationship effect of replicate. A diallel analysis was thereafter set up to estimate general and specific combining abilities using Genstat (1996) and Dial98 package (Ukai 2002).

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## Results

Analysis of variance of effects showed that age, dam genotype, and sire genotype all had a significant ( $P < 0.05$ ) effect on feed efficiency (FE). Feed efficiency values among sires show G and A cocks had no difference in FE with a value of  $0.22 \pm 0.02$  while N cocks had the least value ( $0.12 \pm 0.02$ ). The efficiency of feed utilization among A, B, and G hens show no significant difference ( $P > 0.05$ ) while the least figure is recorded for N hens ( $0.14 \pm 0.01$ ). The means of FE as affected by age showed that FE reduced with age. The result of the general combining ability (GCA) for FE shows that A had the highest value of  $0.07 \pm 0.00$  while the least was B ( $-0.09 \pm 0.00$ ). G and N had  $0.00 \pm 0.00$  and  $0.02 \pm 0.00$ , respectively. The results of specific combining abilities (SCA) reveal a genotypic combinations' potential for trait improvement due to dominance effects. The best combining genotypes for FE was Giriraja by normal indigenous cross (GN) with a value of  $0.08 \pm 0.01$  while the least value was  $-0.12 \pm 0.01$  for AN. Other crosses, AG and AB, had  $0.00 \pm 0.01$  and  $0.04 \pm 0.00$ , respectively while GB and NB both had  $-0.04 \pm 0.00$ .

## Discussion

Sire and dam genotypes were important in determining feed efficiency in these chicken breeds. Anak Titan consumed the most feeds and gained the most weight due to the need to sustain its high metabolic activity and muscular growth. This was followed by Giriraja, a dual-purpose breed. The Normal indigenous and Alpha had gone through long-term natural selection to consume less feed with reduced growth, therefore for every gram of feed consumed, the exotic birds grew more. This result corroborates with the findings of Halima et al. (2006) who worked with indigenous chickens and their crosses with exotics. The Alpha hens' performance shows that further improvement on the normal indigenous can speed up genetic gains for feed utilization. The feed efficiency results show that efficiency reduced with age (Halima et al. 2006). As birds grow, more nutrients are diverted from growth to other activities such as maintenance and reproduction, thereby reducing efficiency. The result of the diallel analysis shows the Anak Titan had the highest

GCA, therefore exhibiting the lowest gene frequency for feed efficiency. This results from long-term selection for efficiency of feed utilization in the breed, which is one of the determinants of a good broiler. Other breeds had higher gene frequency most likely as a result of nonintense selection for the traits. The GCA result of the normal indigenous might have been overestimated as a result of feed wastage due to scratching. This was also observed by Halima et al. (2006). Both crossbreeding and selection pressures will improve these traits. The Anak Titan will be a good sire to use in such an improvement program. The results of the SCA on feed efficiency show Giriraja, by normal crosses, had the highest individual line performance. Such a cross will serve as a good dam line for feed efficiency improvement.

## Conclusion

Sire and dam genotypes were important in determining feed efficiency in these chicken breeds. Anak Titan showed the highest GCA and therefore is recommended as a sire line while Giriraja by normal indigenous cross show responses of a good dam line. Additive and dominant effects control feed efficiency, therefore improvement will both be a combination of crossbreeding of the exotics and indigenous and thereafter selection.

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