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BREED EFFECT ON POST-PARTUM GROWTH PERFORMANCE TRAITS OF THREE BREEDS OF PIGS RAISED IN ASABA TROPICAL ENVIRONMENT

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Abstract

The study was conducted to determine breed effect on post-partum growth performance traits of three breeds of pigs. A total of 72 piglets derived from three breeds of the domestic pig were used. These comprised 24 piglets per breed which were randomly selected and placed in three replicate pens of 8 piglets per genotype across breed were used for this study. The growth curves showed the same sigmoid growth pattern in Figures 1 to 5. At birth, the Landrace was the heaviest followed by the Duroc and the least was the Large White. At the end of the experiment the trend changed as the Duroc became the heaviest of the three, followed by the Landrace and lastly the Large White. Litter size had very high significant (P<0.001) effect on live body weight in weeks 4 to 16, 20 and 24 to 36 and was significant (P<0.05) at 0 week. At birth those dams with 5 piglets per litter had the highest body weight, followed closely by those with 4 piglets per litter and dams with 3 piglets per litter and lastly the dam with 8 piglets per litter. Litter size and breed had very high significant effect on live body weight and birth weight declined as litter size increased. The Duroc and the Landrace were superior to the Large White breed in live body weight performance and are recommended for pork production enterprise under the Asaba tropical environment.

Keywords: *Post-partum, breed, growth trait, performance, environment*

Introduction

The optimization of pork production systems, including the evaluation of alternative management and marketing strategies, requires knowledge of the between and within pig variation in body weight. Little research has been conducted on the growth of pigs from birth to 22.68kg live weight. Heavier pigs at birth and weaning have a competitive advantage and remain heavier throughout their stay in the group. The relationship between the serial live weights and variation in live weight both within and between pigs may be evaluated by the use of nonlinear mixed effects model (Craig and Schinckel, 2001). With the implementation of early weaning in many production systems, the success of nursery feeding programs will be influenced by weaning weight and its variation. This is because the nutrient requirements of the young pig change so rapidly, small variations in weaning weight require different management strategies and labour intensity in the nursery. Experience demonstrates that the younger and lighter the pig, the more difficult it is to manage in the nursery. Data also indicate that lighter weight pigs at weaning are at a higher risk of death than heavier pigs.

Piglet birth weight affects future growth, composition and mortality. Evidence that pigs with low birth weights grow slower, are fatter and are more likely to die before weaning. From 1998 to 2007, the average number of fully formed pigs (born alive plus stillbirths) in the United States has increased from 10.2 to 11.1 pigs per litter (PigCHAMP, 2007). Studies have reported negative genetic correlations (Kaufmann *et al.,* 2000) between birth weight and litter size and lower individual birth weight as the result of greater number born alive (Fix and See, 2008). This combination of factors suggests that an increased incidence of low birth weight pigs occurs within commercial swine production. Birth weight declined as litter size increased; however, of particular interest is the fact that the variation in birth weights (standard deviation) was similar across litter size groups. In other words, as litter size increased, birth weight declined but the variation in birth weight was unaffected. Indeed, throughout the growing period; there was no increase in body weight variation due to litter size. And, by the end of the nursery phase, there was no difference in body weight due to litter weight either (Arango *et al*., 2005., Bergsma *et al.*,2008; Chen *et al.*, 2009; Hu *et al.*, 2010)

It has been hypothesized that light birth weight pigs have poorer post-weaning growth performance, which can be attributed to differences in nutrient digestibility (Meuwissen and Goddard, 2010). However, few experiments have examined these associations, and to our knowledge, none have been conducted in a commercial environment.

Materials and Methods

The study was conducted at the Pig Breeding and Genetic Research (PBGR) unit of the Department of Animal Science of Delta State University, Asaba Campus. A total of 72 piglets of genotypes derived from the Duroc, the Landrace and the Large White genotypes of the domestic pig (*Sus scrofa domesticus)* respectively were used. This comprised 24 piglets per genotype which were randomly selected and placed in three replicate pens of 8 piglets per genotype were used for this study. Feed and water were given *ad-libitum* and all the necessary prophylactic medications were given throughout the experimental period. The animals were housed in a concrete floor, well ventilated and fly-proof pig house and all the measurements like body weight, litter weight, litter-size and weaning weight were taken using standard methods. All data collected were subjected to analysis of variance (ANOVA) in a one-way classification in a completely randomized design of a computer data processing package (SAS, 2010) and in accordance with the guideline by Steel *et al.* (1997) with genotype and age as the sources of variation. The new Duncan's multiple range test (SAS, 2010) was used to compare significantly different multiple means. The following linear model was used to assess the effect of genotype and age on the parameters monitored.

$X_{ijk} = \mu + T_i + B_j + e_{ijk}$ where

X_{ijk} = an observation made on the k^{th} gilt belonging to the i^{th} genotype during the j^{th} age period;

μ = the overall population mean common to all observations;

T_i = effect of the i^{th} genotype (i = 1, 2, 3);

B_j = effect of the j^{th} week of age/ (j = 22, 24, 26, 28, 30, 32,…);

e_{ijk} = random error associated with the experimental determinations.

Results and Discussion

Presented in Table 1 are descriptive statistics values for the pigs' progeny in kg aged 0 to 36 weeks. Very highly significant ($P< 0.001$) differences existed in weeks 0, 4, 8, 12, 16, 20, 24, 32 and 36 while highly significant ($P< 0.01$) genotype difference was recorded at week 28 only. The mean birth weights of the pigs across breeding groups were 0.86 ± 0.05 (Large White), 1.26 ± 0.06 (Duroc) and 1.35 ± 0.11 (Landrace) while the weights at the end of the experiment were 16.03±0.41; 20.14±0.62 and 18.86± 0.97 respectively for the Large White, the Duroc and the Landrace which also showed very high significant ($P< 0.01$) difference among breeds. There was a continuous increase in the body weights as the age in weeks progressed. The growth curves showed the same sigmoid growth pattern in Figures 1 to 4. At birth, the Landrace was the heaviest followed by the Duroc and the least was the Large White. At the end of the experiment the trend changed as the Duroc became the heaviest of the three, followed by the Landrace and lastly the Large White. Significant genotype difference registered in this study was in contradiction with the report of Walugembe *et al.* (2014) who reported non-significant ($P>0.05$) breed effect on the body weight of Ugandan village pigs (Large White, Landrace and some crosses) which they attributed to the fact that the genetic potential from the improved breed animal is not that high and that the feeding regime do not allow improved to express their potential. The mean birth weight recorded for the Large White in this study compared favourably with mean birth weights of 0.93 ± 0.02 kg, 0.80kg, 0.92kg and 0.93kg reported by these authors in Nigerian indigenous pigs (Adeoye, 2002; Aladi *et al*., 2008; Ajayi and Akinokun, 2013). The mean weaning weights registered in the present study are also in line with the mean weaning weight of 5.87kg reported by Adebambo (1986) and higher than the mean weaning weight of 4.03 ± 0.55 kg observed by Ajayi and Akinokun (2013) for the same breeds of pigs.

The finding of this study contradicts the report of Adeoye e*t al.* (2012) who reported a non-significant effect of genotype on the weekly body weights of the F_1 progenies produced by the Large White and the Duroc which they attributed to non-significant difference in their nursing ability. The difference in the findings may be attributed to differences in environment, feeding and other management practices since the pigs were not raised in the same environment. Growth performance is an important factor in animal production and it determines the rate of progress made most especially in pig production. It is also an important component in pig industry in determining profits in a short period of time. Knowledge of growth performance of pigs is essential for designing breeding programmes for commercial production of pigs. Piglet birth weight affects future growth, composition and mortality. The level of management of farms in Africa influenced weights and measurements of different livestock (Chen *et al.,* 2009).

Birth weight is the most important determinant of weaning weight, one of the key components of Weaning Capacity. Although it is difficult to influence, there are several things that may improve it. Recent French research suggests that the addition of oil to the diet (total 5 per cent oil) may lead to fewer stillbirth pigs, improved survival of smaller piglets and higher weaning weights. Correct feed levels throughout the breeding cycle and attention to sow health will also contribute to improved birth weight (Ladokun *et al.,* 2006). Weaning weight is an extremely important component of weaning capacity and also has a major influence on growth and feed efficiency from weaning to market. An increase in weaning weight of 0.5kg, which is possible on many farms, can boost weaning capacity by up to 35kg, assuming 70 pigs weaned per sow lifetime. Genetics plays a significant role in improving weaning weight and Hypor’ selection index places major emphasis on piglet quality traits such as birth weight, survival to weaning and weaning weight (Weber, 2009).

Table 1: Effect of breed on mean Body weight Statistics of the Pigs' Progeny from 0 to 36 weeks of age

AGE (WKS)	LARGE WHITE	DUROC	LANDRACE
0	0.86 ± 0.05^{b}	1.26 ± 0.06^{a}	1.35 ± 0.11^{a}
4	4.79 ± 0.17^{b}	4.71 ± 0.23^{b}	5.16 ± 0.37^{a}
8	6.63 ± 0.28^{b}	5.73 ± 0.23^{c}	7.62 ± 0.41^{a}
12	7.10 ± 0.32^{b}	7.10 ± 0.29^{b}	9.73 ± 0.67^{a}
16	8.81 ± 0.39^{b}	8.70 ± 0.30^{b}	11.50 ± 0.74^{a}
20	10.42 ± 0.44^{b}	10.78 ± 0.37^{b}	13.01 ± 0.86^{a}
24	11.71 ± 0.42^{b}	12.99 ± 0.47^{b}	15.03 ± 1.01^{a}
28	13.09 ± 0.41^{b}	15.54 ± 0.65^{a}	16.06 ± 0.99^{a}
32	14.42 ± 0.42^{b}	17.37 ± 0.69^{a}	17.30 ± 0.40^{a}
36	16.03 ± -0.41^{b}	20.14 ± 0.62^{a}	18.86 ± 0.97^{a}

For each row of results, differing superscript letters indicate mean values with significant differences (P<0.01)

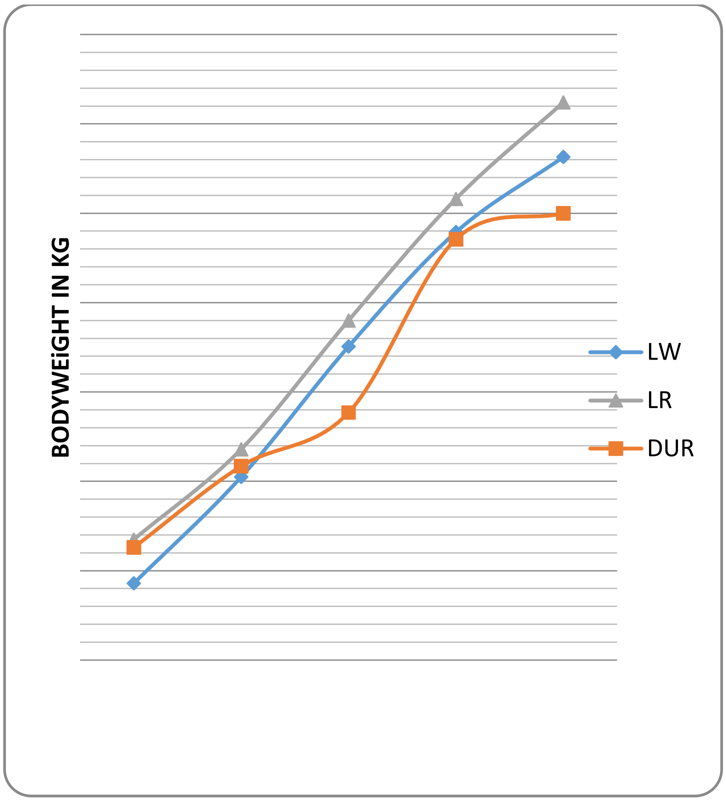

Figure 1: Growth curve for the effect of breed

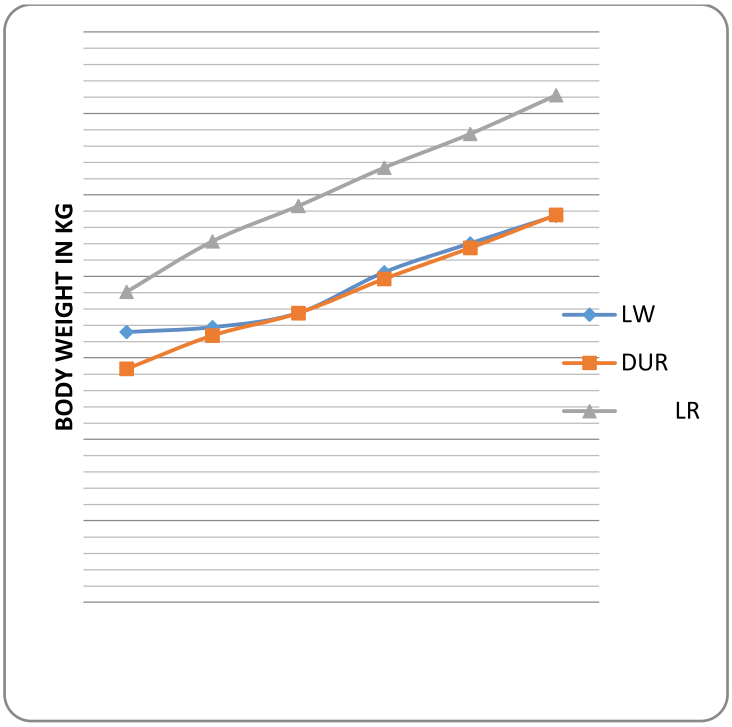

Figure 2: Growth curve for the effect of breed and age on the body weight from 0 to 6 week and age on the body weight from 8 to 18 week

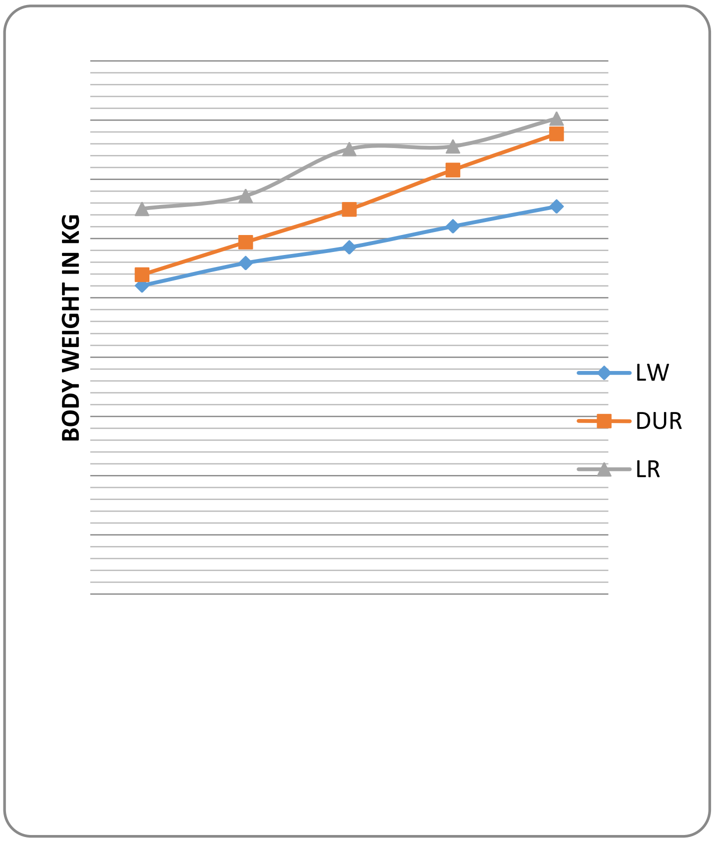

Figure 3: Growth curve for the effect of breed

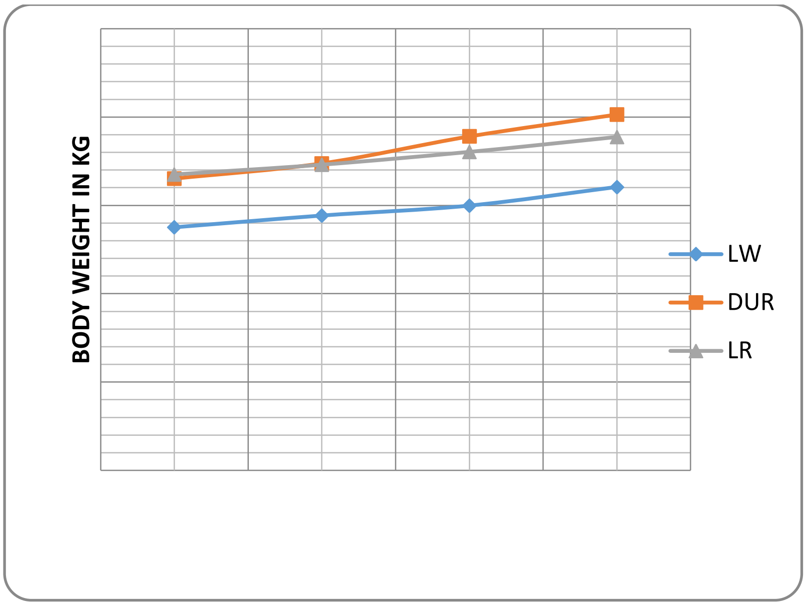

Figure 4: Growth curve for the effect of breed and age on the body weight from 20 to 28 week and age on the body weight from 30 to 36 week

Litter size had very high significant (P<0.001) effect on live body weight in weeks 4 to 16, 20 and 24 to 36 and was significant (P<0.05) at 0 week (Table 2). At birth those dams with 5 piglets per litter had the highest body weight, followed closely by those with 4 piglets per litter and dams with 3 piglets per litter and lastly the dam with 8 piglets per litter. As the weeks progressed, the offspring of those dams with litter size of 3 had the highest live body weight which was significantly higher than other litter sizes. It was also observed that those dams with higher litter sizes had lower body weights throughout the experimental period. From the results presented it is evident that litter size had serious effect on the growth rate of the body weight. The weight across different litter sizes increased with increase in the age of the piglets. The mean live body weights at birth were 0.93± 0.01, 13± 0.05, 1.27± 0.07 and 0.79± 0.07and at end of the experiment 23.16± 1.42, 19.24± 0.79, 15.98± 0.63 and 14.75± 0.99 for 3, 4, 5 and 8 litters respectively.

Birth weight declined as litter size increased; however, of particular interest is the fact that the variation in birth weights (± standard error) was almost similar across breeding /litter size groups. In other words, as litter size increased, birth weight declined but the variation in birth weight was unaffected. Indeed, throughout the growing period; there was no increase in body weight variation due to litter size. And, by the end of the nursery phase, there was no difference in body weight due to litter weight either. The present finding was in line with the report of Arango *et al.* (2005)., Bergsma *et al.* (2008) Chen *et al.* (2009) and Hu *et al.* (2010) who reported declines in birth weight with increased litter size. Several studies have also reported negative associations between litter size and individual birth weight Kerr and Cameron, 1995; Roehe, 1999; Sorensen *et al.*, 2000). Studies have reported negative genetic correlations (Kaufmann *et al.*, 2000) between birth weight and litter size and lower individual birth weight as the result of greater number born alive (Fix and See, 2008). This combination of factors suggests that an increased incidence of low birth weight pigs occurs within commercial pig production.

The production of large litters of high quality piglets with good, even birth weights is an important aspect of maximizing weaning capacity because it results in the highest number and weight of piglets weaned (Das, 2010). Attention to the areas of management discussed below will help to achieve this goal. Litter size is an important contributor to maximizing weaning capacity because number of pigs weaned per litter is a key component in its calculation. However, it is pointless having large numbers of piglets born if this results in an unacceptable level of losses due to stillbirths and pre-weaning mortality.

Table 2: Effect of litter size on mean live Body weight measurements in kg from birth to 36 Weeks of age

Age (Wks)	Litter size			
	3 piglets	4 piglets	5piglets	8 piglets
0	0.93± 0.01[b]	1.13± 0.05[a]	1.27± 0.07[a]	0.79± 0.07[c]
4	6.67± 0.39[a]	5.33± 0.20[b]	4.31± 0.17[c]	3.27± 0.28[d]
8	7.56± 0.52[a]	7.53± 0.30[a]	6.16± 0.26[b]	3.75± 0.42[c]
12	8.25± 0.56[a]	8.23± 0.32[a]	7.06± 0.36[b]	4.50± 0.62[c]
16	9.56± 1.03[a]	9.88± 0.41[a]	8.71± 0.40[b]	6.30± 0.73[c]
20	13.01± 1.06[a]	11.77± 0.59[b]	10.29± 0.45[c]	7.15± 0.80[d]
24	15.66± 0.72[a]	14.77± 0.62[b]	11.38± 0.4 [c]	9.86± 1.01[d]
28	18.50 ± 2.75[a]	16.06± 0.69[b]	13.07± 0.55[c]	11.43± 1.15[d]
32	22.33± 0.33[a]	18.35± 0.72[b]	14.39± 0.60[c]	13.93± 1.12[d]
36	23.16± 1.42[a]	19.24± 0.79[b]	15.98± 0.63[c]	14.75± 0.99[d]

For each row of results, differing superscript letters indicate mean values with significant differences (P<0.01).

The high significant (P<0.01) breed effect on mean litter weight at different days interval (Table 3) revealed the Large White recording the highest values followed by the Duroc and then the Landrace breeding groups with the exception of litter birth and 7th day weights where the Landrace had higher weight than the Duroc. As expected, the litter weight increased as the age in week progressed. The mean litter birth weight across breed were 7.32 ± 0.06kg (LW), 3.86 ± 0.05kg (DUR) and 5.74±0.41kg (LR) while the mean litter weaning weight were 29.68± 0.23kg (LW), 23.60 ±0.23kg (DUR) and 22.66 ± 0.48kg (LR). The present finding on mean litter birth weight conform with that 5.44 ± 0.12 kg, 6.01kg and 6.00kg; 5.22 kg and 5.0 kg reported by Adeoye (2002); Aladi *et al*. (2008) and Ajayi and Akinokun (2013). The values fall within the range of 2.99 - 8.17 kg reported by Sunday (1997) and 6.50 ± 0.09kg reported by Oseni (2005). The mean litter weaning weights in this present study compared favourably with that 23.39 ± 0.55 kg obtained by Ajayi and Akinokun (2013) and lower that 32.46 ± 2.50 kg recorded by Oseni (2005).

The findings of the present study on mean birth weight are in line with the report of Kumari *et al.* (2008) and Prakash *et al.(200*8) and Prasanna *et al.* (2009) who reported a mean litter birth weight of 7.53 ± 0.12 kg, which was well within the range of 5.92 to 9.20 kg, as published in literature on LWY crosses. The mean litter weaning weight from this study is at variance with 60.77 ± 1.00 kg which is also well within the range (55.14 to 64.23 kg) in LWY crossbred pigs published by Kumari *et al.* (2008) and Prakash *et al.*(*200*8). The contradictions in the mean litter weight at weaning may be attributed to the fact that the pigs used in the present study are inbred line and as a result inbreeding coefficient must have set in or as a result of difference in environment since the present study was carried out in the tropic while their own study was in the temperate region.

The significant effect of genetic group on both the litter weight at birth and weaning in the present study are in line with that reported by Nath *et a*l. (2002), Kotirathnam *et al* .(2002), Nandakumar *et al.*(2004) and Prakash *et al.* (2008) in LWY and their crosses. The effect of genetic group was non-significant on both the litter weight at birth and weaning in a study carried out by Prasanna and co-workers in 2009 which was in contrast with the present finding.

Conclusion

However, with this improvement come concerns about "unintended consequences" of larger litter size, such as increased level of management to maintain pre-weaning mortality at acceptable levels, reduced performance in grow-finish, greater variability of growth, and impaired pork quality. The three pig breeds studied displayed similar sigmoid growth patterns. The experimental pigs irrespective of genetic group made their most gain in growth at the self-accelerating phase of growth. Litter size and breed had very high significant effect on live body weight and birth weight declined as litter size increased. The Duroc and the Landrace were superior to the Large White breed in live body weight performance and are recommended for pork production enterprise under the Asaba tropical environment.

Table 3: Effect of breed on mean Litter weight for the day interval body weight measurements of the pigs' in kg 0 to 63 days of age

Age in Days	Large White	Duroc	Landrace
0 (birth)	7.32 ± 0.06^{a}	3.86 ± 0.05^{c}	5.74 ± 0.41^{b}
7	10.83 ± 0.07^{a}	6.98 ± 1.66^{c}	8.30 ± 0.19^{b}
14	16.36 ± 0.15^{a}	11.92 ± 0.10^{c}	12.89 ± 0.23^{b}
21	20.80 ± 0.15^{a}	16.16 ± 0.15^{b}	13.02 ± 0.27^{c}
28	24.88 ± 0.17^{a}	19.95 ± 0.17^{b}	19.05 ± 0.35^{c}
42 (weaning)	29.68 ± 0.23^{a}	23.60 ± 0.23^{b}	22.66 ± 0.48^{c}
56	32.90 ± 0.20^{a}	27.40 ± 0.30^{b}	$26.41\pm 0. 60^{c}$
63	45.63 ± 1.69^{a}	30.16 ± 0.33^{b}	29.20 ± 0.69^{c}

For each row of results, differing superscript letters indicate mean values with significant differences (P<0.01).

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