



Reproductive Performance of ASF-recovered Pigs in South-West Nigeria

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ABSTRACT

This study was carried out to investigate litter traits performance of ASF-recovered pigs at Teaching and Research Farm of Federal University of Agriculture, Abeokuta. Data were collected on 52 progenies farrowed by eight (8) sows and two (2) boars, comprising of four (4) Large White sows, two (2) Large Black sows, two (2) Duroc sows, one (1) Large White boar and one (1) NigerHyb boar. These are survivals from ASF outbreak in 2005. Data were collected on the litter traits and subjected to General Linear Model (GLM) procedure using SAS, (1999) statistical package. Results obtained revealed that the litter traits estimates for the cross among the Large White were 6.52±0.26 (litter size at birth), 5.72±0.23 (litter size at weaning), 6.92±0.34 kg (litter weight at birth), 1.05±0.01 kg (average pig weight at birth), 7.08±0.35 (average pig weight at weaning), 12% (pre-weaning mortality) and sex ratio at birth (52%) and at weaning (54%). In the crosses between Duroc and NigerHyb, and Large Black and NigerHyb, effect of dam genotype was significant ($P<0.01$) on litter weight at birth and weaning, litter size at weaning and average pig weight at birth, higher values were observed in the cross between Large Black and NigerHyb, but not significant on litter size at birth and average pig weight at weaning. The litter traits estimates observed in this study are similar to those reported before the outbreak of ASF in 1997 in Nigeria.

Keywords: ASF; Litter traits and Pigs

1. INTRODUCTION

The demand for animal products has increased in the last decades, especially for poultry and pork. Pork production has increased drastically globally. Pig production is believed to play a crucial role in poverty alleviation, because of the ability to convert low quality feed into high quality protein together with high reproductive potential (Emma Tejla, 2012).

The Nigerian indigenous pigs are found in the southern part of the country and mostly along the coast of West Africa. They are small bodied, produce small litters and roam about as scavengers in compounds and villages. Nigeria was declared free of African swine fever disease (ASF) up to 1996 (Ayodele and Adeyemi, 2003).

ASF outbreak in countries where infection persists is closely linked to production and management systems with the different routes of transmission depending on the type of system adopted in the area. Some of the production and management systems involving the highest risks include; small holdings, extensive pig farms and intensive fattening units. Where ASF infection persists, factors such as the growth in pig production and the excessive concentration of poor farm lay-outs, as well as considerable movement of animals, contribute to the persistence of the disease.

Pork products may contain ASF infected meat, the disease can pass unnoticed in the abattoir. The animals may either be in incubation or may be affected with carrier animals. Should the virus persist after the products have been processed, these products may be a source for disease spread when food waste is fed to pigs.

Antiabong *et al.*, (2007) observed that in domestic pigs, vertical transmission plays a central role in the epizootics of the disease specifically in cases when the antigens are presented to the foetus before development of the immune responses and in this regards immune responses to these particular antigens would therefore be minimal. This might enable the antigen to persist indefinitely in the animal.

The first outbreak of the disease was recorded in Kenya (Montgomery, 1921), after which it was reported in South Africa and Angola ((Dekock *et al.*, 1940 and Velho., 1956). ASF has been reported in all countries of Southern, Eastern and Central Africa only with the exception of Lesotho and Swaziland (Penrith., 1998, Wilkinson., 1984). In West Africa, ASF outbreaks have been recorded in Cameroon, Cape Verde islands, Guinea Bissau, Senegal and Cote d'Ivoire (Penrith M. L., 1998). Between 1997 and 1998, there were ASF outbreaks recorded in Togo, Benin and Nigeria (Penrith, M. L., 1998).

The first outbreak in Nigeria, which occurred in September 1997, that was associated with a spread of the epizootic from Benin. An unprecedented high rate of mortality among pigs was first recorded from four local government areas of Ogun State in the south-west, these include, Ipokia, Yewah- South, Yewa-North, and ImekoAfon, border to Benin republic. Another ASF outbreak was also recorded in the contiguous Lagos State from the end of 1997 to early 1998 (Odemuyiwa, *et al.*, 2000).

In 1998, unconfirmed ASF disease outbreak was suspected in parts of the country (FAO, 2000). This wave of ASF outbreak started about in August 1998 and involved six states of the Nigerian federation, these states include Kaduna state (in the North-west) and Benue State (in the north-central), and Enugu, Akwa Ibom, Rivers and Delta States (in the south). Sufficient evidence was however available to confirm the outbreak of 1997-1998.

Odemuyiwa, *et al.*, 2000 isolated ASF virus from 1997-1998 outbreak and thereby recorded the first confirmed outbreak of ASF in South-West Nigeria. The second outbreak

was in 2001-2002 and was confirmed by Olugasa, *et al* 2007. The third wave of the outbreak was recorded between 2004 and 2005.

The disease is caused by African Swine Fever virus (ASFV), a large double-stranded DNA-virus and sole member of the family *Asfarviridae*. (Dixon, *et al.*, 2000). African Swine Fever (ASF) is a lethal and economically devastating haemorrhagic swine fever that affects domestic pigs. It is highly contagious. The disease is of high economic importance both globally and in sub-Saharan Africa where demand for animal protein including pork has greatly increased in the last two decades (FAO, 2011 and Thomas, *et al.*, (2013).

The virus is very resistant and can, for example, persist in tissues for several months (Costard, *et al.*, 2009) and 1000 days in frozen meat (Sánchez-Vizcaíno, *et al.*, 2012). ASFV can also persist two months in pig faeces (Sánchez-Vizcaíno, *et al.*, 2009). Moreover, the virus is resistant to changes in temperature and pH, meaning that smoked, salted or dry pork products are as big risk as raw or frozen ones (Penrith & Vosloo, 2009). However, temperatures greater than 60°C for more than 20 minutes will inactivate the virus (Emma Tejla, 2012).

ASF can be confused with several other diseases. The differential diagnosis of ASF are implicated in the following five diseases namely: hog cholera, haemorrhagic septicaemia, encephalomyocarditis of pigs, trypanosomosis and anthrax (FAO, 2000).

African swine fever (ASF) is a lethal disease of domestic pigs often characterized by haemorrhagic fever and with mortality rates up to 100%. The disease is endemic in most sub-Saharan countries. The main transmission routes were trade of live pigs and pig products, especially at onset of an outbreak (introduction into a village). When the virus had been introduced into a village, it was probably spread through swill/waste and direct contact between domestic pigs, both of which are facilitated through the traditional free range pig husbandry system and lack of biosecurity (Emma Tejla, 2012)

African swine fever (ASF) is a serious, viral disease of pigs. ASF is highly contagious, although not zoonotic (Wilkinson, 1984). The disease is manifested by high fever, loss of appetite, haemorrhages in the skin and internal organs, and in some cases, eventual death. Pigs that apparently recover from the disease become virus carriers (Sánchez-Vizcaíno, *et al.*, 2015). The level of tolerance depends on the virulence of the strain, intensity of exposure and pig breed (Penrith, *et al.*, 2005).

ASF is a highly contagious viral disease of domestic pigs responsible for a wide variety of clinical symptoms. In the typical and acute form, the lymphoreticular endothelial cells are affected resulting in widespread haemorrhages. Morbidity and mortality classical approach 100%. In sub acute cases pigs lose condition and die of pneumonia. Chronically survivors are characterized by emaciation, stunted growth, haemorrhagic necrosis of skin overlying bony protuberances, followed by abscessation and deep ulceration (Isaac, 2012)

Spread of infection of ASF can be very rapid in pig population by direct or indirect contact. There is no vaccine nor treatment. African swine fever is a serious problem in many African countries including Nigeria.

Antibodies are usually not detected in pigs infected with highly virulent ASF Virus as the pigs die before the antibodies are produced. Antibodies are produced in pigs infected with low or moderately virulent ASF viruses.

Methods employed for detection of ASF include; Direct Immunofluorescence (DIF), haemadsorption reaction, Enzyme-Linked Immunosorbent Assay (ELISA) and pig inoculation. The disease can be confirmed and differentiated from these diseases by

conducting virus isolation and characterization detection of genuine DNA by PCR and serological tests such as immunoblotting assay and ELISA etc. High mortality (FAO, 2000) among pigs of all ages is a strong suspicion of ASF.

The norms recommended for control, formulated in 1961 and enforced over the last twenty years, are as follows:

1. Quarantine of affected farms and neighbouring farms.
1. Compulsory notification of the disease, whether clinical or suspect.
2. Sample collection and despatch to the official laboratory for diagnosis.
3. Compulsory slaughter of all pigs on an affected farm (sick, suspect and healthy animals).
4. Disposal of carcasses and contaminated products, disinfection, disinsectisation and desinfestation.
5. Control of swine movement in infected areas, prohibition of removal of pigs from infected zones.
6. Disinfection of vehicles.
7. Prohibition of fairs and markets according to the location of the outbreaks.
8. Ban on feeding pigs with uncooked domestic and abattoir waste.
9. Introduction of a small group of sentinel pigs for virus detection before total repopulation permitted.
10. Prohibition of pig farms annexed to restaurants, canteens, abattoirs, meat factories, knackers, etc.
11. Control of ticks and other vectors in extensive farming areas.
12. Vaccination against classical swine fever (hog cholera) with identification of animals.
13. Organisation of a surveillance service in the field including specialised personnel and organisation of a laboratory diagnosis service with specialised personnel and equipment for differential diagnosis of swine fevers. (C. Sánchez Botija, 1982)

There have been several works on the reproductive performance of pigs before and after the outbreak of ASF in Nigeria (Adebambo and Dettmers, 1979; Adebambo, 1983 and Ikeobi, 1994), knowing that this factor determines the profitability of pig enterprise. Much consideration has however not been giving to the health status of the animals relative to this factor.

The serological test carried out throughout the South West Nigeria between 2006 to 2007 showed that 92.9% of the sampled herd were positive (Olugasa, 2007). This showed that virtually the whole region is endemic with ASF. Furthermore, there is no vaccine against the disease and mass slaughtering of the infected and survivors has been the only available means of preventing further transmission

This result in the reduction in the total pig population which in turn results in drastic reduction in the yield of animal protein from pig industry.

Therefore, there is an urgent need to look beyond slaughtering of these survivors and infected pigs, therefore the objectives of this study are:

1. To confirm the presence of ASF antibody in the survivors and
2. To investigate the reproductive performance of ASF-recovered pigs.

2. MATERIALS AND METHODS

2. 1. Description of the study Location of the experiment

The experiment was carried out at the Piggery Unit, Teaching and Research Farm, Federal University of Agriculture, Abeokuta, Nigeria. The study location lies within the latitude 7°10' N, longitude 3°2' E and at an of altitude 76 m. The area is situated in the savannah vegetation zone. It has a humid climate with mean annual rainfall of about 1037 mm and average temperature of about 34.7 °C (Google Earth, 2006).

2. 2. Experimental Animals

A total of eight sows (4- Large White, 2- Large Black and 2- Duroc) on third parity and two boars (Large White and NigerHyb) were used for the study. The pigs were the survivals from the ASF outbreak of 2005 at the piggery Unit of the institution, these were mated and produced 52 progenies.

2. 3. Management of the Experimental Animals

Experimental animals were housed in pens throughout the study. Standard daily routine management practices were adhered to. These include cleaning and washing of pens and utensils. Feed and drinking water were supplied to the experimental animals *ad libitum*. Boars were introduced to sows in heat and monitored through mating, gestation, farrowing and nursing.

2. 4. Experimental Design

The foundation stocks were grouped into two, based on the optical density of their sera. Group A comprised four Large White sows and one Large White boar with high optical density (≥ 0.50). Group B comprised two Large Black sows and two Duroc sows and one NigerHyb boar with low optical density (< 0.50).

Mating was carried out in each group as shown below:

♂		♀	
LW	X	LW	= LW
NH	X	LB	= LBNH
NH	X	D	= DNH
LW	=	Large White breed	
D	=	Duroc breed	
NH	=	NigerHyb breed	

2. 5. Data collection

2. 5. 1. ELISA tests on blood samples

Blood samples were collected from the foundation stock and were subjected to ELISA test to confirm the presence of ASF antibody in their blood serum.

2. 5. 2. Data on litter traits performance

Data were collected on the litter traits performance of the pigs.

Data collected include the following;

- Litter size at birth (LSB),
- Litter weight at birth (LWB),
- Average pig weight at birth (APWB),
- Litter size at weaning (LSW),
- Litter weight at weaning (LWW),
- Average pig weight at weaning (APWW),
- Sex ratio at birth and
- Weaning and pre-weaning mortality.

Data were collected according to the method described and adopted by Adeoye, *et al.*, (2003).

2. 6. Data analysis

Statistical Analysis were carried out on the data collected. Data collected on the litter traits were subjected to General Linear Model (GLM) procedure using SPSS version 20 statistical package to compare the means.

New Duncan Multiple Range Test was used to separate the means that differed significantly (Gomez and Gomez, 1984). The statistical model used is as follows:

$$Y_{jk} = \mu + B_j + \epsilon_{jk}$$

where,

Y_{jk}	=	Observation on reproductive traits
μ	=	Overall means
B_j	=	effect of genotype (1 - 3)
ϵ_{jk}	=	experimental error

The correlation among the litter traits were computed using Pearson's correlation procedure of SAS, (PROCCORR) (1999).

3. RESULTS

Table 1 shows the litter traits performance of Large White (LW) pigs with high optical density.

Table 1. Litter traits performance of Large White (LW) with high optical density.

Parameters	Means
Litter size at birth	6.52±0.26
Litter size at weaning	5.72±0.23
Litter weight at birth (kg)	6.92±0.34
Litter weight at weaning (kg)	38.85±1.31
Average pig weight at birth (kg)	1.05±0.01
Average pig weight at weaning (kg)	7.08±0.35
Pre-weaning mortality (%)	12
Sex ratio at birth (%males)	52
Sex ratio at weaning (%males)	54

Table 2. Shows the effect of dam genotype on litter traits performance of Large White (LW) pigs with low optical density.

Table 2. Effect of dam genotype on litter traits performance of pigs with low optical density.

Parameters	Genotypes		
	NHLB	NHD	Overall
Litter size at birth (LSB)	7.57±0.53	6.85±0.42	7.22±0.34
Litter size at weaning (LSW)	7.57±0.53 ^a	4.62±0.14 ^b	6.15±0.40
Litter weight at birth (LWB)	10.00±0.19 ^a	7.91±0.25 ^b	8.99±0.25
Litter weight at weaning (LWW)	44.04±1.99 ^a	28.18±1.31 ^b	36.40±1.96
Average pig weight at birth (APWB)	1.40±0.09 ^a	1.18±0.04 ^b	1.29±0.05
Average pig weight at weaning (APWW)	5.98±0.18	6.29±0.49	6.13±0.25
Pre- weaning mortality (%)	0.00	30.80	14.80
Sex ratio at birth (%males)	35.70	53.50	44.40
Sex ratio at weaning (%males)	35.70	77.80	52.20

^{a, b} Means in the same row with different superscripts are significantly different ($P<0.05$)

The Litter Size at Birth (LSB), litter Size at Weaning (LSW), Litter Weight at Birth (LWB) and Litter Weight at Weaning (LWW) for the Large White were 6.52±0.26, 5.72±0.23, 6.92±0.34 kg and 38.85± 1.31 kg, respectively, while Average Pig Weight at Birth (APWB), Average Pig Weight at Weaning (APWW), Pre-Weaning Mortality, Sex Ratio at Birth and at weaning were 1.05±0.01 kg, 7.08±0.35 kg, 12%, 52% and 54% respectively. Effect of dam genotype was highly significant ($P<0.001$) on LSW, LWB, LWW and APWB.

However, the effect was not significant ($P>0.05$) on LSB and APWW. The cross between NigerHyb and Large Black had the highest mean value for LSW (7.57±0.53), LWB (10.00±0.19); LWW (44.04±1.99 kg) and APWB (1.40±0.09 kg) while the mean values for cross between NigerHyb and Duroc were lower in the four traits. The pre-weaning mortality for the cross between NigerHyb and Duroc was 30.8% while for NHLB was 0%. The sex ratio at birth and at weaning for NHLB showed more females while NHD showed more males at birth and at weaning.

Table 3 below shows the estimates of correlation coefficients between litter traits considered among pigs with high optical density.

Table 3. Correlation coefficients among litter traits of pigs with high optical density.

Parameters	LSB	LSW	LWB	LWW	APWB	APWW
LSB	1.000	0.957***	0.993***	-0.228NS	0.767***	-0.881***
LSW		1.000	0.927***	-0.133NS	0.583NS	-0.857
LWB			1.000	-0.337NS	0.837***	-0.915***
LWW				1.000	0.679NS	0.624NS
APWB					1.000	-0.829
APWW						1.000

*** $P < 0.0001$

NS = Not significant

The estimates ranged between -0.915 to 0.957. The correlations between LSB/LSW, LWB/APWB were positive and highly significant ($P<0.001$). Low and non-significant ($P>0.05$) correlation existed between LSB/LWW (-0.228). The correlation between LSW with LWB, LWW, APWB and APWW were 0.927, -0.133, 0.583 and -0.857 respectively.

The correlations among the litter traits of pigs with low optical density are shown in Table 4 below.

Table 4. Correlation coefficients among litter traits of pigs with low optical density.

Parameters	LSB	LSW	LWB	LWW	APWB	APWW
LSB	1.000	0.776***	0.729***	0.392***	-0.789***	-0.849***
LSW		1.000	0.905***	0.870***	-0.337***	-0.484***
LWB			1.000	0.684***	0.157**	-0.660***
LWW				1.000	-0.004NS	0.007NS
APWB					1.000	0.596***
APWW						1.000

** $P < 0.05$; *** $P < 0.0001$;

NS = Not significant

The litter size at birth was significantly correlated ($P < 0.05$) with all the traits considered, and the values ranged from -0.789 to 0.776. The correlations between LSW with LWB, LWW, APWB and APWW were 0.905, 0.870, -0.337 and -0.484 respectively. Low and non-significant relationship ($P > 0.05$) existed between LWW/PWB and LWW/PWW.

4. DISCUSSION

The litter traits of Large White pigs with high optical density can be compared with the works of earlier researchers. The litter size (6.52 ± 0.26) is similar to 6.3 reported by Dan and Summers (1996) for the same breed while higher value was reported by Nwakpu and Ugwu (2009). Litter size at weaning (5.70), litter weight at birth (6.92) and litter weight at weaning (38.85) are lower to the values reported by Sai, *et al.* (2009), though these can be compared with the work of Kumari, *et al.* (2008) in India.

The pre-weaning mortality (12%) observed in this study can be compared with the work of Ibom, *et al.*, (2010). Larger percentage of the mortality resulted from neonatal mortality which occurred as a result of cold and crushing by the dam. The differences observed between the litter traits of Large White in this study and estimates reported by earlier researcher can be attributed to differences in management and environmental factors.

The litter traits observed for the cross between NigerHyb and Large Black, and NigerHyb and Duroc are comparable to the findings of Ncube, *et al.*, 2003. Dam genotype had significant effect ($P < 0.0001$) on litter size at weaning, litter weight at birth, litter weight at weaning and average pig weight at birth.

These agree with the observations of Nwakpu and Ugwu (2009). The effect of dam genotype was not significant ($P>0.05$) on litter size at birth and average pig weight at weaning.

This could be attributed to similarity in ovulation rates and nursing ability respectively. Most of the litter traits were significantly higher in the cross between NigerHyb and Large Black than the cross between NigerHyb and Duroc. This indicates that the genetic diversity between NigerHyb and Large Black is likely to be more than that of NigerHyb and Duroc. The sex ratio at birth and at weaning for the genotypes shows that more females were farrowed and weaned. This is in line with the findings of Adebambo (1986). The 30.8% mortality reported for NHD is higher than what Adebambo (1986) reported but similar to the findings of Machebe, *et al.* (2010).

Correlations among the litter traits of different crosses considered show variations and similarities. The estimates ranged from low to high, negative to positive and some were significant while some were not as reported by earlier researchers (Staner, 1986 and Sai, *et al.*, 2009). The litter traits performance of ASF recovered pigs are comparable to those reported in Nigeria before the outbreak in 1997.

5. CONCLUSION

The litter traits estimates observed in this study are similar to those reported before the outbreak of ASF in 1997 in Nigeria. This shows that the ASF recovered pigs can be used for further production after the outbreak. And that the use of mass slaughtering of the infected and survivors as the only means of preventing further transmission should be discouraged

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