Sjournals
Scientific Journals
Scientific Journal of Animal Science (2014) 3(11) 268-274
ISSN 2322-1704
doi:10.14196/sjas.v3i11.1750

Contents lists available at Sjournals
Scientific Journal of Animal Science
Journal homepage: www.Sjournals.com

Original article

# Pig farms' typology and African swine fever's epidemiology in Parakou's district in North of Benin

**E.Y. Attakpa[a,*], Y. Akpo[a], N.B.A. Amadou[a], D.Y.G. Awohouedji[b], F. Djegui[c], A.K.I.Youssao[d]**

[a]*Laboratoire de Productions Animales et Halieutiques, Faculté d'Agronomie, Université de Parakou. Benin Republic.*
[b]*Laboratoire d'Ethnopharmacologie et de Santé Animale Faculté des Sciences Agronomiques Université d'Abomey-Calavi. Benin Republic.*
[c]*Laboratoire de Diagnostic Vétérinaire et de Sérosurveillance (LADISERO), Direction de l'Elevage. Parakou, Benin Republic.*
[d]*Ecole Polytechnique d'Abomey-Calavi (EPAC). Université d'Abomey-Calavi Benin Republic.*

*Corresponding author; Laboratoire de Productions Animales et Halieutiques, Faculté d'Agronomie, Université de Parakou. Benin Republic.

ARTICLE INFO

*Article history,*
Received 02 November 2014
Accepted 20 November 2014
Available online 29 November 2014

*Keywords,*
Pig
African swine fever
Epidemiology
Typology
Parakou

ABSTRACT

One most worrying diseases in pig breeding in Benin is the African swine fever (ASF) which made important economic losses. This study aims to make Parakou's pig farms's typology and ASF's epidemiologic's study. A survey was been done on 10 % Parakou's pig's farms number that's mean 69 farms. For ASF's epidemiologic study, 41 samples of organs (liver, lungs, spleen, kidneys and heart) and 24 samples of blood serum were carried out. These samples were analyzed by the Polymerase chain reaction (PCR) and the Enzyme-linked immunosorbent assay (ELISA). Three breeders groups were been identified. The average number of pigs per farms was 15.78 ± 11.15. In group 1, the breeders had provided with schooling and practiced an intensive breeding. In group 2, they were extensive breeders with a little technical knowledge. Finally, group 3 was for semi-intensive breeders who practiced quarantine and who used kitchen residues in pigs' feeding. The laboratory analyses revealed that 78.05% of the organs subjected to the PCR were positive against 12.5% of serum by the ELISA test. The rates of positivity observed by organ were respectively of 31.21%, 28.12%, 18.75, 12.50% and 9.38% for the liver, the lungs, the spleen, the kidneys and the heart. It was

noted that the expression of ASF in the different types of pig farms is under the influence of the mode of pig conduct, the practice or not of the quarantine of animals, heating of feeds containing fatty water and the number of pig herds. The reduction or elimination of the risk factors seems the starting point for an effective fight against this viral disease of swine which decimates the pigs' farms and impoverishes people.



## 1. Introduction

In Benin, livestock contributes for 25% of agriculture's GDP. The national meat production is 61,646 tons in 2011 with 56.75%, 18.94%, 7.46%, 7.46% and 4.05% for beef leads, poultry, sheep and goats and rabbits and cane rats respectively (CountryStat, 2012; Salifou et al, 2012). These productions aren't enough for Benin's people needs (Salifou et al., 2012). This situation can be partly explained by the low productivity of local breed ruminants'. To increase meat production, promotion and improvement of animal husbandry short cycle including pork are required.

Since ten years, pigs' breeding is constantly increasing particularly in the southeast of the country. Indeed, in south of Benin, there is approximately 80% of national pigs' herd. Pigs, number were estimate to 600,000 animals before ASF apparition in 1997 (MAEP 2004). Pigs' breeding is done both Parakou's suburban and urban areas. Nowadays Parakou's pigs' breeders faced many problems such as feeding and health management. Among health managment, African Swine Fever (ASF) occupies a special place. Indeed, the ASF is an epizootic which causes a high mortality rate (Deka et al. 2008). ASF's direct and indirect losses were been valued at more than 90 % of the herd in 2007 (Deka et al., 2008). These losses were seen by some breeders as inevitable although the ASF remains a threat and its eradication seems tricky. Instead of being seen as a foregone conclusion, the ASF should be considered a pathological entity whose causes, risk factors and control methods are known. The present study aims to determine pigs' farms typology to do an epidemiological study of ASF in Parakou.

## 2. Materials and methods

### 2.1. Study area

This study was conducted in the town of Parakou, located in the Borgou (Figure 1). It is located at 9 ° 21 'north latitude and 2 ° 36' east longitude with an average altitude of 350 m. The population of the town of Parakou is predominantly peasant and the main activities conducted are agriculture, livestock breeding and fisheries.

Local breed pigs were been used for the study. They were the most pigs used in Parakou's farms. Its diet consists mainly of agricultural by-products, meat byproducts and food waste. Pigs are subject to irregular health monitoring.

We have also used a lasso, a pair of scissors, gloves and a curved forceps to remove the organs, plastics bags and markers. The samples are packaged in plastics bags and placed in a cooler with an average temperature of + 4 ° C. Syringes were used for the collection of blood in heparinized tubes in order to obtain blood serum.

The lab material consisted of Pasteur pipettes used for prepared solutions' samples, sterile sand, mortar, pestle used for grinding organs removed and then Vortex, used to mix solutions contained in microtubes.

We have also used a thermocycler for amplifying in vitro specific DNA sequence, a centrifuge whose role is to separate the compounds of the two phases according to their density, extractor facilitating aseptic manipulation samples, protection of the operator and the environment, a Roch® kit used for DNA extraction, a loading buffer that allows the DNA sample to sink into the wells of agarose gel during electrophoresis while preventing it from diffusing into the transport solution, the 2% agarose gel which forms the support of migration of the DNA during electrophoresis, the gel red which is incorporated in the DNA so that it emits fluorescence proportional to the amount of incorporated molecule.

### 2.2. Survey and samples collecting

Data collection was conducted through structured interviews done with questionnaire. The survey form was used to collect information relating to the breeders' identification, prophylaxis rules, herd's size and structure, animal's health status, ectoparasites and feeding method. The surveys were conducted from May 2012 to September 2013 in 15 Parakou's districts which are Albarika, Amanwion, Arafath, Banikanni, Dokparou, Ganon, Kpérou Gera Monnon, Souinrou, Tihan, Titirou, Tibona, Tranza, and Wansirou Wore. Based on pigs' breeders list provided by Ministry of Agriculture, Breeding and Fisheries' agents, 69 farms in three Districts of the Commune of Parakou were been selected by random sampling for investigation. A total of 1,089 pigs was investigated (Table 1). During the survey, blood samples and organs were collected. A total of 41 organs and 24 blood serums were collected. These organs were then placed in ice and stored at - 20 ° C in Veterinary Diagnostic Laboratory (LADISERO) of Parakou for analysis.

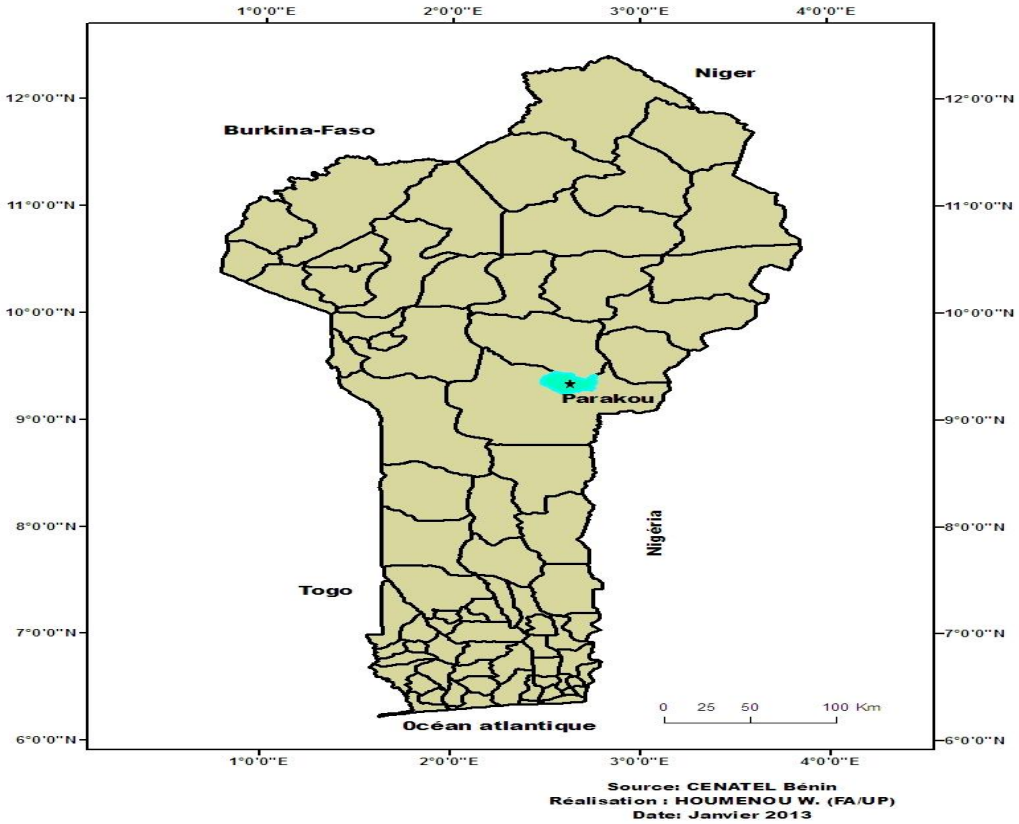


**Fig. 1.** Study area.

**Table 1**
Farms' distribution.

| Districts | Farms' number | Pigs' number | Farms' frequency (%) |
|---|---|---|---|
| 1st | 26 | 466 | 37,68[a] |
| 2nd | 15 | 249 | 21,75[b] |
| 3rd | 28 | 379 | 40,57[a] |
| Total | 69 | 1089 | 100 |

Frequencies in the same column followed by different letters differ significantly at 5%..

### 2.3. Laboratory analysis

Two analyzes were carried out, it is the polymerase chain reaction (PCR) carried out on organs and the enzyme immunoassay solid support (ELISA) on serum extracts blood samples. PCR was to detect and identify the

viral DNA of ASF's viral agent into pigs' organs. The main steps were the preparation of the sample followed by extraction of the DNA with the Rosh Kit. The protocol used to perform PCR is described in the Manual of Diagnostic Tests and Vaccines for Terrestrial Animals (OIE, 2008). The ELISA was to titrate antibodies, control of infection by ASF's virus. The protocol used for the ELISA test is described in the Manual of Diagnostic Tests and Vaccines for Terrestrial Animals (OIE, 2008).

### 2.4. Statistical analysis of data

The collected data were encoded using the spreadsheet Excel 2007. R® software version 2.14.1 was used for data processing. The multiple correspondence analysis and hierarchical clustering were used to determine the types of farms. As for assumptions about risk factors for ASF in pig farms, they were tested by the Chi2 test of the SPSS software, version 1998. The bilateral Z test of SAS (1991) was used for comparison of prevalence of ASF.

## 3. Results

### 3.1. Farms' typology

The average number of pigs in the farms surveyed was 15.78 ± 11.15 pigs. These pigs were predominantly local race. In addition, 4.34% of the farmers surveyed use Landrace and Large White parents. Three pigs' breeding modes were been found, non confined (23.85%), semi-confined (37.02%) and confined (39.13%). In confined farms, breeders respected quarantine rules; however, the pig feed was not balanced. Likewise, those lodging weren't comfortable for pigs. The workforce was mainly family. All these features allowed us to qualify those exploitations as traditional family farms.

According to correspondence analysis (AFC) results, we had three groups of farms (Figure 2). With the first three axes, more than 50 % of survey's information were been taken into account. These axes are then used to interpret the results.

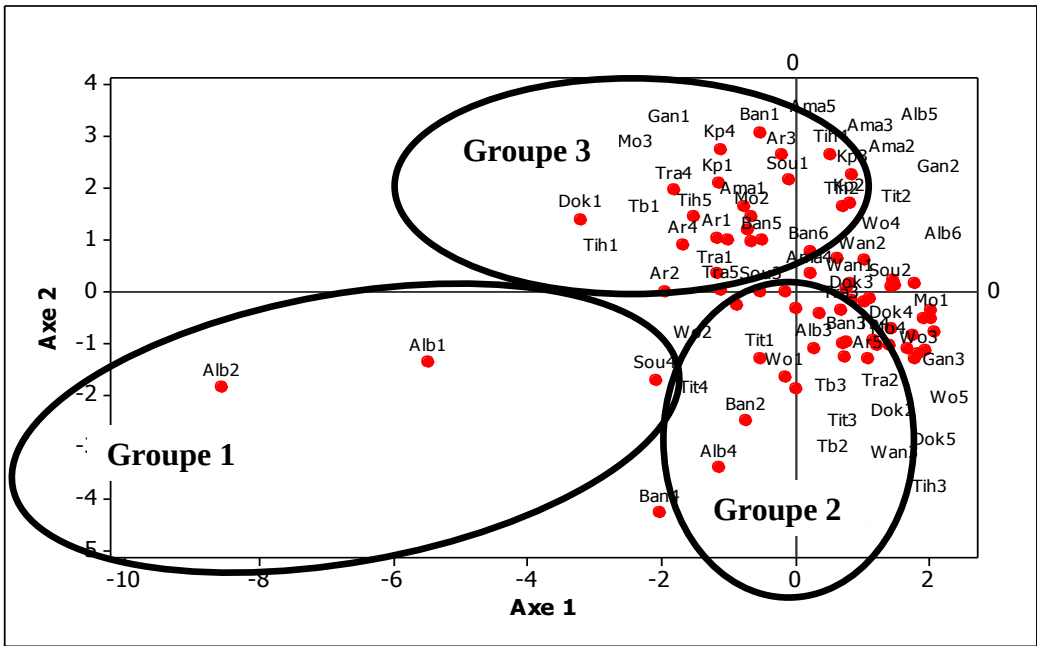


**Fig. 2.** Pigs' farms typology on the factorial design represented by the first two axes.

Caption, The letters represent the city districts surveyed and the numbers of livestock serial number surveyed in these urban neighborhoods as follows,

Group1, Alb1, Albarika1, Alb2, Albarika2, Alb3, Albarika3, Alb4, Albarika4, Ban2, Banikanni2, Ban3, Banikanni3, Ban4, Banikanni4, Sou4, Souinrou4, Tit1, Titirou1, Tit4, Titirou4, Wo1, Woré1, Wo2, Woré2

Group2, Ar3, Arafath3, Dok2, Dokparou2, Dok4, Dokparou4, Dok5, Dokparou5; Gan3, Ganon3; Mo1, Monnon1, Mo4, Monnon4; Tb2, Tibona2, Tih3, Tihan3; Wo2, Woré2, Wo5, Woré5

Group3, Alb5, Albarika5, Alb6, Albarika6, Ar 4, Arafath4, Ama4, Amanwion4, Aman5, Amanwion5; Ban1, Banikanni1, Ban5, Banikanni5; Gan1, Ganon1, Gan2, Ganon2; Kp2, Kpérou Guerra2, Kp3, Kpérou Guerra3; Mo2, Monnon2; Tb1, Tibona1; TIH1, Tihan1, Tih4, Tihan4; TRA1, Tranza1, Tra3, Tranza3, TIT2, Titirou2; Wan1, Wansirou1, Wan2, Wansirou2

Regarding the contribution of the different modalities of the variables on each axis, Albarika and Banikanni were well represented on axis 1. Souinrou, Amanwion and Tihan were well represented on the axis 2, while Wore, Arafath and Tranza were well represented on the axis 3.

The first factor differentiates farmers trained and educated on driving patterns of pig, pig with a high effective and having sires one hand, and untrained and uneducated farmers, having a small operation and borrowing breeding males to females protrude other.

The second axis opposed non confined animals throughout the year to confined ones. The use of quarantine for newly pigs purchased, and health management with drug were also represented on this axis. Finally, dead animals due to diseases are very well represented on the third factorial axis. In total, three types of farms were identified.

In type 1, the animals were confined. The breeders were educated and trained in pigs' breeding. They had a high herd size (36 ± 15 pigs) and gave more endogenous and veterinary drugs to the animals. This type of farming was met in Albarika, Titirou and Wore.

In type 2, the breeders were illiterate and not trained in pig breeding. The animals were non confined in the day and spent the night in an enclosure throughout the year. In this type of farming, animals were every night, food supplemented with kitchen waste. This type of breeding is found in the outskirts of the city of Parakou including Dokparou.

In type 3, the animals were bred in semi-confinement. In this type of farming, pigs were food supplemented with meat by-products preheated. This type of farming is found in Parakou's neighborhoods. The herd size was 15 pigs. of farms of this type is,

### 3.2. ASF's risk factors

ASF's risk factors identified were wandering pigs, new pigs introduction without observing the quarantine, lack of heating kitchen and meat by-products and high herd size.

The manifestation of ASF in pigs' farms surveyed in Parakou strongly depends on the type of breeding. Indeed, there was a lot of ASF's cases types 2 and 3 farms where the animals where not confined and prophylaxis rules not respected.

The PCR have shown thirty-two tested positive that's means a rate of 78.05%. The results of the organ performed by PCR analysis are shown in Table 2. The virus of the African swine fever has been found in the liver more (31.21%) than in the other organs. After the liver, the lungs were respectively (28.12%), spleen (18.75%), kidneys (12.50%). The heart is the organ where the ASF virus was the least detected (9.38%). ELISA meanwhile revealed three positive samples on twenty analyzed (12.5%).

**Table 2**
PCR results.

| Organs analyzed | Prevalence (%) |
|---|---|
| liver | 31,21[a] |
| lung | 28,12[a] |
| Rate | 18,75[ab] |
| kidney | 12,5[b] |
| Heart | 9,38[b] |

Frequencies in the same column followed by different letters differ significantly at 5%.

## 4. Discussion

We have found three groups of breeders, non confined (23.85%), semi-confined (37.02%) and confined (39.13%). Our method has been used by Kiendrebeogo (2008) when studying the pigs' breeders' typology of urban

and suburban areas of Bobo-Dioulasso in Burkina Faso. All the farms are characterized by a little prophylaxis rules, unbalanced feeding, family workforce and uncomfortable enclosures. These observations were also made by Dick and Geert (1995) in the tropics, Sorin (2002) in Togo and Youssao et al. (2008) in the City of Abomey-Calavi in Benin Republic. Sinturel (2009) has found the same breeding method on different group, but average herd size in his group 1 is lower than ours. On the other hand, Deka et al. (2008) and Youssao et al. (2009) have found in the southern Benin the same typology with group 2's herd size lower than ours. Finally, our group 3 has the same herd size (15 pigs) that Youssao et al. (2008) type 3.

ASF's risk factors identified were wandering pigs, new pigs introduction without observing the quarantine, lack of heating kitchen and meat by-products and high herd size. These ASF's risk factors have also been reported by Lau et al. (2001) in family farming in Uruara (Brazil) and Ndiaye (2007) in Fatick, Kolda and Ziguinchor in Senegal. The presence of ticks on animals has not been shown to be a risk factor for ASF because of the scarcity of ticks on pigs and regular external deworming. This result differs from that obtained by Grenier (2004) in Lake Alaotra (Madagascar), which indicated that the presence of ticks on pigs was a risk factor for the ASF. This difference can be explained by the fact that this author has worked in a forest area where vectors and reservoirs of ASF abound.

ASF disease manifestation depend on the group where an exploitation is located, that's means the type of breeding. Indeed, confined animals have a prevalence rate lower than others. Kiendrebeogo et al. (2008) in urban and suburban pig farms in Bobo-Dioulasso (Burkina Faso) and Costard et al. (2009) have found the same thing and have reported a relationship between the type of farming and the manifestation of ASF in pig herds. Also, we have different prevalence rate with the test used. Indeed, PCR is a direct test which highlights viral material when ELISA looks for viral material antibodies against the virus in the blood serum DNA. In addition, it is possible that this difference lies in the choice of the samples because the samples analyzed by PCR are different from those submitted to ELISA. Similarly, the point at which samples are taken is important in terms of the kinetics of antibodies that usually appear between the 7th and 10th day after infection. Finally, one possible reason for this difference may be that the ELISA test does not usually detect antibodies in infected with a virulent ASF because he died before they occur. Thus, the case may involve only tested positive pigs infected with strains of low or moderate virulence. PCR's prevalence rate (78.05%) is higher than those of 11.50% and 14.76% respectively found by Atuhaire et al. (2013) in Uganda and Owolodun et al. (2010) in Nigeria who have all worked on samples of slaughterhouse's pigs. These differences may be related to the circulation of less virulent ASF virus in Benin. Serological surveys conducted in 2002 in Benin in 5000 animals showed an overall prevalence of 9.7%, with differences from one region to another ranging from 5% to Ouémé and the two northern areas, 15% for southern regions other than Ouémé, first affected by the ASF (Sorin, 2002). The same author established ASF's prevalence in Togo to 26.4%. the differences between ours results and those of Sorin (2002) can be explained by the fact that he had access to a very large number of animals tested (5000) in contrast to this study where the analysis focused only of 41 animals. But ASF's prevalence in urban and suburban areas of Parakou found by the ELISA method is similar to that of Sorin (2002) found for Benin's national prevalence rate which is 9.7%. These results are also similar to those reported by Ndiaye (2007) in Senegal (prevalence of 16.9%), where the pigs' breeders typology is similar to Parakou's in Benin.

## 5. Conclusion

This study identified three groups of pig farms. These groups are distinguished by the size of the herd, the application of prophylaxis rules, breeders education level and the type of feeding. The main risk factors for high ASF's prevalence are determined. ASF's risk factors identified were wandering pigs, new pigs introduction without observing the quarantine, no application of prophylaxis rules, lack of heating kitchen and meat by-products and high herd size. The study also led to the identification of the most vulnerable farms to ASF in Parakou. So it is urgent to scrupulously respect the rules of medical prophylaxis to better control the ASF for a better development of the pig industry in Benin.

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