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Identification of factors influencing the circulation of African Swine Fever virus in apparently healthy pig farms in Chad

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Abstract

The objective of study is to identify the factors influencing the circulation of the African Swine Fever virus (ASFV) in apparently healthy pig farms. The study was realized in the provinces of Chari Baguirmi, Mayo Kebbi East and N'Djamena. Started with is census of 492 farmers who had already registered ASFV. Among them 198 consented to participate in this study. Total of 346 sera were collected and analyzed by the competition ELISA for the detection of antibodies directed against the ASFV. Intrinsic factors influencing ASFV circulation on farms had variable seroprevalences. They were 18.51 % in whole boars and 16.21 % in castrated boars. In sows 6.66 % in pregnant sows and 14.59 % in non-pregnant sows (P = 0.0061). Extrinsic factors were linked to the floor of the pigsty with seroprevalence of 19.56 % in baked bricks and 18.36 % in earth (P = 0.00405). Seroprevalence of 4.72 % among stray pigs (P = 0.0008459) and 18.05 % among farmers who introduced a new pig into their herds (P = 0.007634). Seroprevalence of 20.27 % was linked to the presence of mole ticks in buildings (P = 0.00000036). This work showed that ASFV circulates in pig farms in Chad, without any visible clinical signs. Factors influencing circulation of the ASFV in pig farms are linked to the physiological and general state of the pigs, breeding system, floor of the pigsty, means of transport of boars and sows for reproduction, to presence of ticks in buildings and farmers' poor knowledge of biosecurity. Presence of this virus in pig farms is maintained by the failure to control the chain of contamination of the disease and poor breeding practices. ASF is far from being eradicated in Chad. Administrative and health authorities must intensify awareness campaigns among farmers to control the virus.

Keywords : *influencing factors, competitive ELISA, ASF virus, apparently healthy pigs, Chad.*

Résumé

Identification des facteurs influençant la circulation du virus de la Peste Porcine Africaine dans les élevages porcins apparemment sain au Tchad.

L'objectif principal de cette étude était d'identifier les facteurs influençant la circulation du virus de la Peste Porcine Africaine (PPA) dans les élevages porcins apparemment sain. L'étude a été menée dans la province du Mayo Kébbi Est, Chari Baguirmi et N'Djamena dont 304 fermiers ont été interviewés. Au total 327 sérums ont été collectés et analysés par la technique ELISA compétition. Le logiciel R Studio a été utilisé pour analyser les données. Deux facteurs (intrinsèque et extrinsèque) influencent la circulation du virus dans les fermes. Les séroprévalences étaient de 18.51 % chez les verrats entiers et 16.21 % chez les verrats castrés (P = 0.0061). Chez les truies, 6.66% chez les truies gestantes et 14.59% chez les truies vides (P = 0,0061). Les facteurs extrinsèques étaient liés au sol de la porcherie. La prévalence était de 19.56% dans les sols en briques et 18.36% en terre battue (P = 0.0001812). Une séroprévalence de 19.14% chez les porcs en divagation et de 18.05% chez les fermiers ayant introduit un nouvel porc au sein de leurs troupeaux (P = 0.007634). Séroprévalence de 20,27 % étaient liés à la présence des tiques moles dans les bâtiments (P = 0.00000036). Ce travail a montré que le virus de la PPA circule dans les élevages porcins au Tchad, sans aucun signe clinique visible. Les facteurs influençant la circulation du virus dans les élevages porcins sont intrinsèques et extrinsèques. La PPA est loin d'être éradiquer au Tchad. Les autorités administratives et sanitaires doivent intensifier des campagnes des sensibilisations auprès des éleveurs pour bien contrôler la maladie.

Mots-clés : *facteurs influençant, ELISA compétition, virus de la PPA, apparemment sain, Tchad.*

1. Introduction

The African Swine Fever (ASF) viral infection was first diagnosed in Kenya in 1910 by Montgomery. Described eleven years later (1921) as being different from classical swine fever (swine cholera) and manifests itself as an acute hemorrhagic fever with a mortality rate of 100% in domestic pigs [1]. Introduced in Portugal, and probably coming from Angola, the ASF virus (ASFV) affected Europe for the first time in 1957, then it settled in 1959 in the Iberian Peninsula for more than thirty years. Incursions into other European countries were reported in 2007 in Georgia and the Russian Caucasus, grace to the illicit migratory flow of animals or contaminated animal products [2 - 4]. Recent declarations have come from Uganda in 2012 and then in Taraba State in Nigeria in 2013, in the Kilimanjaro region in Tanzania in 2013 [5 - 7]. Following these initial descriptions, ASF was reported in most countries in eastern and southern Africa as well as on the island of Madagascar where the virus is known to have been present in warthogs, hylohoges and wild boars for long time. In Central Africa, incursions in Sao Tome and Principe in 1979, in the South Kivu province of the Democratic Republic of Congo in 2016 and in Cameroon in 2018 have been officially reported [8 - 12]. Chad experienced ASF for the first time in October 2010. Despite the emergency health measures taken by Chad in veterinary services, the disease was reported less than four months ago (November and December 2010, January and February 2011) in four provinces, namely Mayo-Kébbi East and West, Tandjilé, Logone Occidental and Chari Baguirmi [13]. In 2012, a first outbreak of ASF reappeared in the province of Mandoul and Batha with cases of viral infection in warthogs [14]. In 2018, ASF was once again reported in N'Djamena and affecting the first district, seventh and ninth districts with a mortality rate of 89.72 %. All these periods of epidemics were followed by the culling of large numbers of animals and such an event could contribute to the extinction of local breeds already well adapted to environmental conditions [13 - 16]. Biosecurity failures and poor disease management as well as poor breeding practices (general condition of the pigs, physiological state, type of breeding, breeding system, condition of the pigsty and the movement of animals) would constitute the first factors influencing the circulation of the ASFV in the different provinces and cities of Chad and its persistence in outbreaks. Failures were also observed in the practice of stamping out. According to several authors [13, 15] the risk of ASF endemicity is real after the virus has passed through an area. The general purpose of this study was to identify the factors influencing the circulation of the ASFV in apparently healthy pig farms and to propose a good approach for its eradication in Chad.

2. Material and methods

2-1. Study areas

The study was carried out in the Republic of Chad precisely in four zones, namely ***(Figure 1)***. The sub-prefecture of Rigaza. This is the located 50 km from the town of Bongor. The geographical coordinates of this area carried out by Global Position System (GPS) are : 10°91'604'' of the North attitude and 15°19'604'' of the East-West longitude. The town of Bongor and its surroundings. This is the capital of the province of Mayo Kébbi East, located 240 km from N'Djamena, capital of Chad. The geographic coordinates carried out by GPS : are 10°16'29" North latitude and 15°22'39" East longitude. The city of N'Djamena. This is the political capital, whose geographical coordinates carried out by GPS are : 12°6'47" North latitude and 15°2'57" East longitude. The prefecture of Mailao and sub-prefecture of Mandalia. Whose geographical coordinates of this area carried out by GPS are : 8°31'0'' North latitude and 15°46'0'' East longitude for the prefecture of Mailao and 11°43'37'' North latitude and 15°14'52'' East longitude for the sub-prefecture of Mandalia. These four areas correspond to pig farming areas, the most important in Chad, and are often hit by strong waves of ASF.

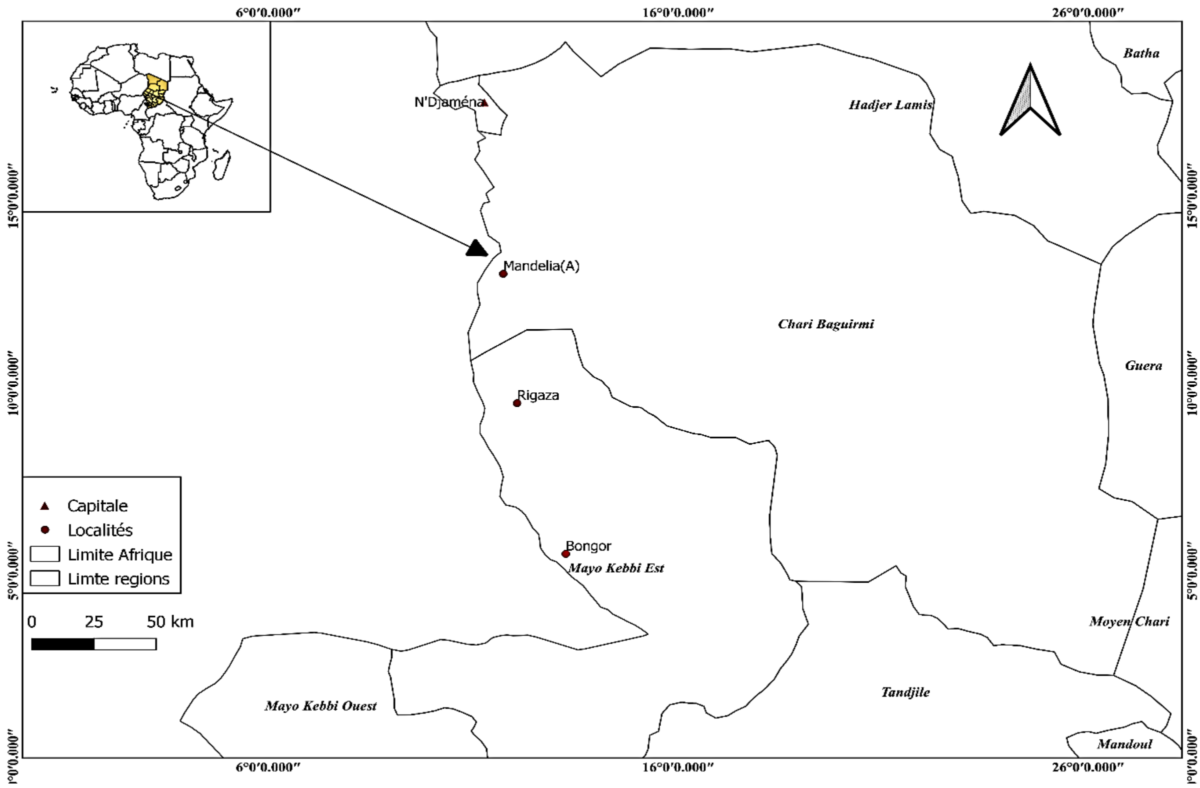

Figure 1 : *Study areas*

2-2. Sampling

The sampling was non-probabilistic and done voluntarily. It began with a census of 492 farmers who had already registered the ASF. Among them, 304 farmers interviewed, 198 breeders agreed to participate in this study, 106 breeders refused to participate in the study and 188 breeders no longer had pigs in their piggeries when the team returned to take the samples. This is to increase the chances of detecting the virus. Then targeted sampling was carried out to choose the areas explored.

2-3. Method for collecting sample and data

The collection of data and sera was carried out from September 2021 to September 2022. Blood sampling of 2 to 4 ml per animal was carried out by puncture of the saphenous vein using a Venoject,® Vacutainers® needle by a member of the team. For each pig sampled, we recorded the intrinsic factors (sex, age, breed, physiological state, general condition, season, type of breeding, floor of the pigsty and bedding) and extrinsic factors (contact with other pig farms, breeding system, means of transporting boars or sows for reproduction, the introduction of a new pig to the farm and presence of mole ticks). The samples were taken from pigs aged 02 to 48 months depending on the size of the herd. Each blood sample collected from a pig was placed in a dry tube and then centrifuged for obtaining of serum antibodies.

2-4. Technique of collecting and analyzing sample

The collected sera are transferred into dry tubes then placed in a cooler containing an ice-pack, then sent to the virology laboratory at IRED and stored at -20°C for later use. Sera antibodies were detected using competitive enzyme-linked immunosorbent ELISA (c-ELISA). Antibodies against ASFVwere detected by the c-ELISA test based on manufacturers instructions.

2-5. Data processing and analysis

The data from the interviews as well as the results of the tested sera were entered into a Microsoft Office 2007 Excel spreadsheet then converted into CSV and then exported into the R Studio software version 4.0.4.2021 for analyses. Regarding analytical statistics, the Chi-square test and Fisher Exact test were used to determine the factors (intrinsic and extrinsic) influencing the circulation of the ASF virus. The significance threshold was set at 0.05 and the P-value calculated using the Fisher Exact Test.

3. Results

3-1. Intrinsic factors influencing the circulation of the ASF virus in this study

The results of our study show that out of 327 sera samples analyzed, 47 were positive, giving an overall seroprevalence of 14.37 % (CI : [10.75-18.65]). This seroprevalence varied according to the intrinsic factors of the pigs and according to the extrinsic factors of the pigs. ***Table 1*** shows the intrinsic factors that influenced the circulation of ASFV in apparently healthy pig farms in the study area. The seroprevalence was 17.18 % in boars and 13.68 % in sows. These two rates were statistically insignificant ($P > 0.05$). The age group of 0 to 4 months had a seroprevalence of 15.78 %, followed by that of 5 to 9 months with a seroprevalence of 25 %. This factor linked to the slices was statistically insignificant ($P = 0.01979$). The seroprevalence was 11.86 % in hybrid breed pigs and 15.78 % in local breed pigs ($P > 0.05$). The factors influencing ASFV circulation related to the physiological state of pigs in this study were highly significant and varied. The rate was 18.51 % in intact boars and 16.21 % in castrated boars as well as disc in sow, it was 6.66% in pregnant sows and 14.59 % in non-pregnant sows (P = 0.0061. The general condition of the animals that were collected was highly significant (P = 0.001204). A seroprevalence of 47.05 % in pigs had petechiae and 13.56 were apparently healthy. Several exogenous variables influenced the circulation of ASFV and its increase in this study.

Table 1 : *Intrinsic factors influencing the circulation of the ASFV linked to: sex, age, breed physiological state of the animal and the state of the pig is condition during sampling*

Factor related to ASF		N	ASF +	SR in %	CI at 95%	P-value	Interpretation
Sex	Sow	263	36	13.68	[9.77-18.44]	0.5507	Non significant
	Board	64	11	17.18	[8.90-28.67]		
Age	0-4month	57	9	15.78	[7.48 - 27.86]	0.01979	Significant
	5-9 month	76	19	25	[15.77 - 36.25]		
	10-14month	95	10	10.52	[5.16 - 18.50]		
	≥15 month	99	9	9.04	[4.24 - 16.55]		
Breed	Local	209	33	15.78	[11.12-21.45]	0.4123	Non significant
	Hybrid	118	14	11.86	[6.64-19.10]		
Physiological state	Whole board	27	5	18.51	[6.30 - 38.08]	P = 0.0061	Highly significant
	Castred board	37	6	16.21	[6.19 - 32.01]		
	non-pregnant Sow	233	34	14.59	[10.32 - 19.78]		
	Sow pregnant	30	2	6.66	[0.81- 22.07]		
General condition	Well	258	35	13.56	[9.63-18.35]	0.001204	Highly significant
	Hyperthermia, anorexic and asthenic	52	4	7.69	[2.13-18.53]		
	Pétéchia	17	8	47.05	[22.98-72.18]		

If P-value > 0.05 in the Fisher Exact and Chi-square Test, the factors are not significant.
If P-value < 0.05 in the Fisher Exact and Chi-square Test, the significant factors
If P-value < 0.00 in the Fisher Exact and Chi-square Test, the factors are very significant

3-2. Extrinsic factors influencing the circulation of the ASFV in this study

These variables are listed in ***Table 2***. The intrinsic factors influencing the circulation of the ASFV in Chad were estimated by analyzing 327 sera including 268 sera in the rainy season, either seroprevalence of 14.55 %, and 59 sera in the dry season, either a seroprevalence of 13.55 % (P > 0.05). Out of 327 sera analyzed, 297 sera came from traditional type farms, either a rate of 15.82 %, and 30 sera came from semi-modern type farms. The seroprevalence was 18.36 % in animals whose floor of the pigsty was earth, 19.56 % whose floor was brick. These results were very significant at the 5 % threshold (P = 0.0001812) and present in ***Figure 2*** and ***Figure 3***. Depending on the presence or absence of litter in the pigsties, the seroprevalence was very high in the pigsties not having litter or 17.67 % but on the other hand it was 3.84% in the porchies with a litter (P = 0.001435) ***(Table 2)***.

Table 2 : *Exogenous factors I*

Factor related to ASF		N	ASF +	SR in %	CI at 95%	P-value	Interpretation
Season	Rainy	268	39	14.55	[10.55-19.35]	1	Non Significant
	Dry	59	8	13.55	[6.04-24.98]		
Type of farming	Traditional	297	47	15.82	[11.86-20.48]	0.01222	Significant
	Semi-modern	30	0	0	[0-11.57]		
Pigsty floor	Concrete in floor	85	2	2.35	[0.28-8.24]	0.0001812	Highly significant
	Bricks	46	9	19.56	[9.35-33.91]		
	Earth	196	36	18.36	[13.20-24.50]		
Litter	Present Straw litter	78	3	3.84	[0.80-10.83]	0.001435	Highly significant
	Absent No litter	249	44	17.67	[13.14-22.98]		

Figure 2 : *Housing partially broken*

Figure 3 : *Floor of the earthen pigsty*

Table 3 lists certain extrinsic factors which influenced the circulation of ASFV in apparently healthy pig farms in Chad. Out of 134 sera collected from animals that were in contact with others, 21 sera tested positive for ASFV, representing a seroprevalence of 15.67 %. In wandering or divagation animals, the seroprevalence was 19.14 % and 21.11 % in those that were temporarily confined ***(Table 3)***. These results were significant (P = 0.0008459). The seroprevalence was 11.14 % among boars and sows transported on foot and 16.96% among those transported by cart and rickshaw ***(Table 3)***. ***Figure 4*** and ***5***, show pigs transported on food and by motorcycle for breeding. These results are highly significant (P = 0.00002678). Of 327 animals collected, 150 had ticks on their bodies. Serological analysis detected 15 animals positive for ASFV, (either a seroprevalence of 20.27 %) These results are very significant (P = 0.00000036) ***(Table 3)***. ***Figure 6*** shows pigs wandering in search of food and water.

Table 3 : *Exogenous factors II*

Factor related to ASF		N	ASF +	SR in %	CI at 95 %	P-value	Interpretation
Contact with other farms	Yes	134	21	15.67	[9.97-22.95]	0.6317	Non Significant
	No	193	26	13.47	[8.99-19.11]		
Farmed system	System confinement	127	6	4.72	[1.75-9.99]	0.0008459	Highly significant
	Temporary	90	19	21.11	[13.21-30.98]		
	Divagation	47	9	19.14	[9.14-33.25]		
	Au piquets	43	8	18.60	8.39-33.40		
Means of transport	On foot	131	15	11.14	[6.55-18.18]	0.00002678	Highly significant
	Motorcycle and bicycle	34	11	32.35	[17.38-50.52]		
	Cart and rickshaw	112	19	16.96	[16.58 ; 17.33]		
Introduction of an animal	Yes	216	39	18.05	[13.16-23.84]	0.007634	Highly significant
	No	111	8	7.20	[3.16-13.70]		
Mole ticks	Yes	150	15	20.270	[19.77 ; 20.76]	0.0000003619	Highly significant
	No	111	8	7.20	[3.16-13.70]		

Figure 4 : *Transport pigs for farmed on foot*

Figure 5 : *Transport pigs by motorcycle*

Figure 6 : *Pigs wandering in search of food and water*

3-3. Risk factor of ASF

In this study, the main risk factors linked to the variation of disease in apparently healthy pig farms are grouped in ***Table 4***.

Table 4 : *Risk factor*

Risk factors	Characteristic	OR	CI at 95 %	P-value
Forest approximated in pigsty	Yes No	4.193	[0.70 -21.48]	0.0916
Knowledge of biosecurity	No Yes	0.121	[0.05 - 0.26]	0.0000000195
Knowledge of ASF	No Yes	2.578	[1.11 - 6.28]	0.003066247
Presence_or absence of tick in pigsty	No Yes	3.071	[1.43 - 6.81]	0.000452000

OR = Odds Ratio, OR > 1 risk factor, OR < 1 and It is protector factor

4. Discussion

4-1. Intrinsic factors influencing the circulation of the ASFV in this study

Influencing the circulation of the ASFV in this study were linked to the physiological state of the pigs which are highly significant and varied. This seroprevalence is 41.39% among boars distributed as follows : 18.51 % among intact boars and 16.21 % among castrated boars. Among females, the seroprevalence is 30.77 % including 6.66 % in pregnant sows and 14.59 % in non-pregnant sows. These results are lower than those of 86.3 % in boars and higher than 13.8 % in sows in the Iringa region in Tanzania [17]. This increase in positive cases among whole boars could be explained by the fact that these boars are lent by neighbors in exchange for a few kilos of rice or sorghum and used as genitor for reproduction. However, these breeders have animals with unknown health status, so most of these animals live wandering and therefore beyond the control of the breeders. These uncastrated boars mate with sows and this explains a high rate of ASFV cases in these pregnant sows. In our series, the anatomophysiological study was discussed. A variable ASFV positivity rate was observed. In total, 47.05 % of the positive pigs had petechiae and died suddenly in the pigsties or around the breeding areas and 15.20 % of the ASF-positive pigs had the impression of being well. These results are similar to those obtained in the Republic of Madagascar, in the Republic of Togo who found 30 % to 70 % of mortality cases in the subacute form, 0 to 100 % in Romania. The mortality rate depends on the virulence of the isolate, and can vary. These very virulent isolates should induce mortality of approximately 100 % [9, 18, 19]. But a rate of 70 % to 80 % was observed in young pigs and less than 20 % in older animals. Two reasons could support our results. First, according to clinically in the case of ASF, petechiae are the first clinical signs that appear in the legs and ears and this leads to sudden deaths in pigs [15]. Secondly, the investigation took place in areas endemic for ASF and these pigs could be in a period of ASFV seroconversion.

4-2. Extrinsic factors influencing the circulation of the ASFV in this study

Concerning extrinsic factors, certain exogenous factors contributed to the circulation of the ASFVin certain apparently healthy pig farms in Chad. The condition of the pigsties influenced the circulation of the ASFV. The seroprevalence varied from 2.35 % and 19.56 % respectively in the pigsties where the floors were made of clay and baked bricks. These results could be explained by the fact that in semi-modern farms, cleaning of the pigsty is generally carried out daily; on the other hand, in traditional farms, the floor being dirt, only a very small proportion of breeders carry out once a month cleaning the pigsties. Many breeders only clean the pigsty when the quantity of excrement is too great and some breeders do not clean the animals' habitats at all. In pigsties where these floors are dirt, it is very difficult to disinfect the pigsty [20]. Our results corroborate these assertions because most pigsties have floors that are either clay or baked bricks. These high positivity rates could also be explained by the low investment of breeders in this sector. This is what contributed to this significant increase in ASFV positive cases in this study. About partial confinement and the introduction of an animal into the herd. They were statistically significant with a rate of 18.05 % of positive cases due to the fact that farmers let their pigs in contact with others. These results are much lower than those of 70.3 % in the Marovoay region in the Republic of Madagascar. In certain township of Marovoay, pig farms are largely of the traditional type [20]. On the other hand, in our study the confinement is partial. Some breeders claim that in the event of given birth, the other animals are kept in neighboring farms, leaving the sow which has just given birth alone in the pigsty in order to avoid the death of the newborns. It should also be remembered that most of the buildings are built of local materials, during the rainy season, the buildings collapse and force them to move their herds to approximate pig farms which also belong to one of their close relatives to prevent them from destroying the fields during the period of field work. These pigsties are largely unsanitary. In this study, 4.72 % of the positive cases of the ASFV were obtained in stray pigs and 18.60 % of the positive cases came from pigs in partial confinement, either the breeders leave their animals either free for a few hours a day or on pickets. Two reasons explain these high rates : Firstly, the non-applicability of the texts by the authorities in charge of breeding and animal production in Chad. Ministerial Order, prohibiting the wandering and movement of pigs not being respected, pigs still continue to wander in the streets and dumps in Chad.

It is enough for a pig to be infected to transmit the virus to other animals during their wanderings in search of food or a bath in ponds, backwaters and rivers [21 - 23]. Several authors have noted cases of direct and indirect contamination. The transmission of the virus can be direct from a sick pig to a healthy pig or indirect using contaminated equipment [23]. Given the great resistance of the ASFV in the external environment and in biological environments, its transmission can be direct from a healthy pig to a sick pig or indirectly via mechanical vectors such as premises, vehicles, instruments or soiled clothing or even by a person who has been in contact with infected animals [24 - 26]. Secondly, most of the respondents affirm that in cases where the pigs are dying in the pigsty, the animal is slaughtered and then the meat is simply dried in the courtyards of the houses which are generally located near the pigsties and then sold in the weekly markets. Some breeders claim to have shared fresh and/or dried meat between themselves and neighbors. An affected pig remains contaminated for 30 days and its meat and dried meat for 300 days. However, in livestock farming areas these practices are common. Some farmers process the meat in an artisanal way, either by drying or by manuring at low temperatures and sell in markets [27, 28]. This is certainly what could explain both the origin of this increase in positive cases among animals in seasonal confinement and the spread of the virus. The circulation of the ASFV in pig farms was linked to the introduction of an apparently breast-feeding animal into a herd. A seroprevalence of 18.05 % compared to 7.20 % who had not introduced a new animal into their herds was observed. The breeders interviewed claim to have introduced at least one pig directly into their herds without any observation of the latter. The ideal would be to observe new pigs purchased before their introduction into the herd. This could help control the circulation of the ASFV or its reintroduction into disease-free pig farms. This is unfortunately not the case in our context. Most pig farms in the different study areas are small farms where no health measures are applied. It should also be noted that there is little knowledge of biosecurity on the part of the pig farmers who participated in this study. As a result, these three zones (Rigaza, Bongor and N'Djamena) border Cameroon and completely escape the control of the MEPA authorities [21].

The means of transport of boars and sows for mating are highly significant and varied. A seroprevalence of 11.14 % is observed in pigs transported on foot and 16.96 % in pigs transported in carts and rickshaws. These results are in agreement with the assertions of the authors who assert that given the great resistance of the ASFV in the external environment and in biological environments, its transmission from pig to pig occurs indirectly via a mechanical vector such as premises and means of transporting animals (vehicles or other means) [24, 25]. In our case, it must be remembered that certain boars and sows are sometimes transported from areas endemic to ASF to areas free of ASF and frequently at nightfall clandestinely, to escape the control of veterinary authorities. As a result, the means of transport for boars and sows are very rudimentary and difficult to disinfect, as well as poor pig breeding practices on the part of the pig breeders surveyed. The application of strict stamping out in a home in accordance with the terms of decrees for the control of ASF has been one of the causes of the rapid spread of viruses. In four months, five unaffected provinces were reached [21, 29, 30]. Breeders fearing the slaughter of their animals transported them away from homes [13, 15]. The presence of mole ticks in buildings is very significant ($P = 0.00000036$). This factor has a high positivity linked to the ASFV with a rate of 20.27 % in the buildings that we inspected and noted their presence. These results are tenderhearted to 20.27 % obtained in Madagascar by [31]. The mole ticks are both reservoirs and vectors of ASFV and can transmit ASFV from an infected pig to a healthy pig and thus allow the passage of the virus from the so-called “domestic” transmission cycle. This could shed light on this very high rate in this study [24, 31].

4-3. Risk factor of ASF

According to the generalized linear regression model, certain factors have influenced seroprevalence in the study. These factors are due to the fact that pig farms are near forests ($OR = 4.19$) but also linked to the knowledge of PPA ($OR = 2.58$). The presence of ticks in porchies constitutes a large risk factor ($OR = 3.07$). On the other hand, knowledge of biosecurity measures constitutes a protective factor ($OR = 0.12$).

5. Conclusion

This study identified factors influencing the circulation of the ASFV in apparently healthy pig farms in Chad. The intrinsic factors influencing the circulation of the ASFVwere linked to the physiological state of the pigs, their general conditions and the floor of the pigsty which were statistically significant. The extrinsic factors linked to the circulation of the ASFV were due to contact with other farms, the straying of pigs, their means of transport for reproduction, the introduction of new pigs into the herd and the presence of mole ticks in pigsties which were relatively very significant. ASF escapes the control of veterinary authorities cause to the non-applicability of the texts in force.

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