Journal of
Animal Health
(JAH)

Swine Brucellosis in the Kadiogo Province of Burkina Faso: Seroprevalence, Knowledge and Zoonotic Transmission Risk Behaviours among Farmers

M.C. Kadja, D. Tialla, W. E. V. Ouedraogo, S. Sourokou Sabi and Y. Kaboret

IPRJB
INTERNATIONAL PEER REVIEWED
JOURNAL AND BOOK PUBLISHING

Journal of Animal Health
ISSN 2709-5517(Online)
Vol.4, Issue 3, No. 1 pp 1-13, 2024

www.iprjb.org

Swine Brucellosis in the Kadiogo Province of Burkina Faso: Seroprevalence, Knowledge and Zoonotic Transmission Risk Behaviours among Farmers

[1*]M.C. Kadja, [2,3,4,5] D. Tialla, [1]W. E. V. Ouedraogo, [1]S. Sourokou Sabi and [1]Y. Kaboret

[1]Inter-State School of Veterinary Sciences and Medicine of Dakar, BP 5077, Dakar, Senegal
[2]Laboratoire de Microbiologie-Epidémiologie, de Zoonoses et de One Health (LMEZOH)
[3]Unité des Maladies à potentiel Epidémique, Maladies Emergentes et Zoonoses (UMEMEZ)
[4]Institut de Recherche en Sciences de la Santé (IRSS)
[5]Centre National de Recherche Scientifique et Technologique (CNRST), Ouagadougou, Burkina Faso

Article History

Received 8th July 2024
Received in Revised Form 11th August 2024
Accepted 13th September 2024

How to cite in APA format:

Kadja, M., Tialla, D., Ouedraogo, W., Sabi, S., & Kaboret, Y. (2024). Swine Brucellosis in the Kadiogo Province of Burkina Faso: Seroprevalence, Knowledge and Zoonotic Transmission Risk Behaviours among Farmers. *Journal of Animal Health*, *4*(3), 1–13. https://doi.org/10.47604/jah.2930

Abstract

Purpose: This study aimed to enhance the understanding of swine brucellosis, a critical zoonotic disease, by determining its seroprevalence in the Kadiogo province of Burkina Faso. Additionally, the study sought to evaluate farmers' knowledge of the disease and identify risky behaviors that may contribute to zoonotic transmission.

Methodology: A cross-sectional serological survey was conducted on 184 pigs using the Indirect ELISA method to detect antibodies against Brucella species. The study involved administering questionnaires to farmers to collect data on their socio-demographic profiles, knowledge of brucellosis, and farm management practices. Associations between seroprevalence and factors such as the pigs' sex, age, and breed were statistically analyzed.

Findings: The overall seroprevalence of swine brucellosis in the province was 23.9%. A higher prevalence was observed in females (25%) compared to males (21.7%), in pigs over one year of age (28%) compared to younger pigs (20%), and in exotic breeds (25.4%) compared to local breeds (19%). The study identified poor hygiene practices, particularly the handling of piglets without protection, as significant risk factors for brucellosis transmission. Only 18.2% of farmers had knowledge of the zoonotic potential of brucellosis.

Unique Contribution to Theory, Practice and Policy: To mitigate the risk of brucellosis transmission, the study recommends the implementation of targeted awareness and training programs for farmers, focusing on improving hygiene and biosecurity practices. It also underscores the importance of adopting a One Health approach to control zoonotic diseases in both animals and humans. Comprehensive surveillance and control measures should be reinforced to prevent further spread.

Keywords: *Brucellosis, Pig, Seroprevalence, Knowledge, Risk of Transmission*

JEL Classification Codes: *Q10, Q18, I18, O13*

INTRODUCTION

Pig farming accounts for 35% of meat production worldwide, on a par with poultry (Youssao et *al.*, 2008; Mopate et *al.*, 2010, 2011a). In sub-Saharan Africa, it accounts for 11.9% of meat production, and grew by 50% between 2007 and 2017. Pork production in sub-Saharan Africa is around 800,000 tonnes, or 1% of global production. In Burkina Faso, pork production, with an estimated herd of 2,641,616 head in 2020, is unevenly distributed across the country due to socio-cultural, religious and climatological specificities (FAO,2012; Kiendrébéogo, 2012). The five largest pig-producing regions in Burkina Faso are Centre-Ouest, Sud-Ouest, Bouche du Mouhoun, Hauts Bassins and Centre-Est (DGESS, 2020). Intensification of pig production, however, comes up against a number of technical (genetics, feed), social (acceptability of farms around residential areas) and health (African swine fever, zoonoses) difficulties. Sanitary issues remain a major concern, especially in terms of public health. Brucellosis is one of the major cosmopolitan zoonoses (Boukary et al., 2014; Olsen et al., 2019; Brier and Lia Dwi, 2020; Kamga et al., 2020; LI et al., 2023).

According to the World Health Organization (WHO), brucellosis is one of the seven most widespread zoonoses in the world (Hull and Schumaker, 2018; Anif et al., 2023). It is caused by various species such as Brucella abortus, Brucella melitensis, Brucella suis, Brucella canis (Diaz aparicio, 2013; Głowacka et al., 2018; Jamil et al., 2022; Kurmanov et al., 2022). Brucella suis is the etiological agent of porcine brucellosis (Miassangoumouka et Banga-mboko, 2019). Porcine brucellosis is an infectious, contagious disease common to many animal species and humans (Hebano, 2013). It is a disease with a worldwide distribution, particularly in developing countries with a strong economic influence (Olsen and Tatum, 2016; Tialla et al., 2018; Gong et al., 2021). Transmission to humans can be direct or indirect, leading to a generally asymptomatic disease (Li et al., 2023). However, this asymptomatic phase gives way to a symptomatic or chronic phase that is very difficult to cure (Li et al., 2023). Although eradicated or in the process of being eradicated in many industrialized countries, this disease remains endemic in developing countries (Ducrotoy et al., 2017). It is still a public health problem today (Boukary et al., 2014).

Every year, over 500,000 new human infections are recorded (Gong et al., 2021). Brucella suis is second only to Brucella melitensis in causing the most severe form of human brucellosis (Nielsen and Yu, 2010, Ducrotoy et al., 2017). Swine brucellosis has been detected in over 170 countries, in six major regions of the world with over 850 million pigs infected with Brucella (Gong et al., 2021). In Africa, brucellosis is often unrecognized or even neglected due to a lack of consideration or simply a lack of suitable diagnostic facilities (Boukary et al., 2014, Kansiime et al., 2014).

Few studies have been carried out on swine brucellosis in Africa. The bibliography provides information on studies by Sehi, 2019 in Côte d'Ivoire, Miassangoumouka and Banga-Mboko, 2019 in Congo Brazzaville and Kamga et al., 2020 in southern Cameroon, which obtained prevalences of 12%, 1.87% and 11.86% respectively for porcine brucellosis.

In Burkina Faso, the study carried out by Tialla in 2021 revealed the disease with a prevalence of 7.7%.

Despite the global and regional significance of swine brucellosis, there remain significant gaps in the understanding of its prevalence and the risk behaviours associated with its zoonotic transmission, particularly in Burkina Faso. Previous studies in West Africa, such as those conducted in Côte d'Ivoire, Congo Brazzaville, and Cameroon, have provided insight into the

disease's presence but lack detailed analysis of the socio-demographic factors and farmer behaviors contributing to its spread. Moreover, no comprehensive study has been conducted in the urban and peri-urban areas of Ouagadougou, a critical gap in the epidemiological mapping of the disease in Burkina Faso.

This study addresses these deficiencies by exploring the prevalence of swine brucellosis in these under-studied regions and examining farmers' knowledge and practices related to zoonotic disease transmission. The outcomes of this study to improve biosecurity practices among pig farmers, guide public health interventions, and contribute to the existing epidemiological data on zoonoses in the region.

MATERIALS AND METHODS

Study Area and Period

The survey was conducted from November 2022 to April 2023 in the province of Kadiogo or Centre region (Figure 1), which comprises seven departments or communes including one urban commune, Ouagadougou, and six rural communes (Koubri, Komsilga, Saaba, Pabre, Komki-Ipala, Tanghin d'assouri).

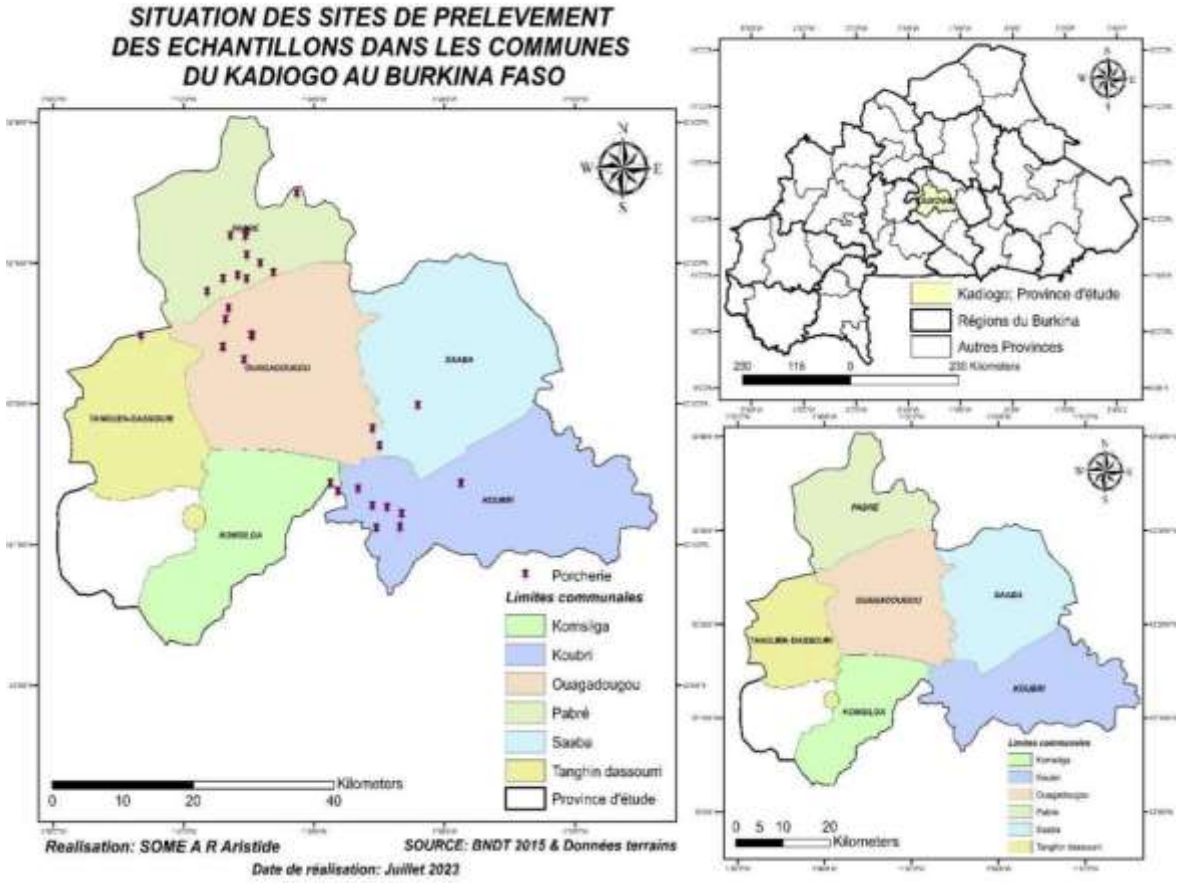

Figure 1: Sample Collection Sites in the Communes of Kadiogo, Burkina Faso

Sampling Method

A two-stage random sampling method was used. The first stage involved the random selection of pig farms. In the absence of exhaustive lists of successive sampling units, a preliminary survey enabled thirty (30) pig farms to be exhaustively identified. After raising awareness, all

farmers with holdings meeting the inclusion criteria (being a pig farm with a herd of at least 10 head) agreed to take part in the study. The second stage involved simple random sampling by numbering the sampling frame, followed by the random drawing of sampling units by lottery. Two visits were made to each farm: the first to raise awareness and obtain verbal consent from each farmer, and the second to administer the questionnaire and take blood samples from the pigs. Of the 30 farms selected, 22 were surveyed, but blood sampling was carried out on pigs at all physiological stages (breeding boars, sows and piglets) on all 30 farms.

Questionnaire Administration and Blood Sampling

The survey was carried out in 23 villages in 5 communes of Ouagadougou. A total of 184 blood samples were taken (Table 1), followed by the administration of a simple closed-ended questionnaire through an interview with the owner of each farm.

The study provided data on the socio-demographic, socio-economic and cultural characteristics of the farmers, as well as the zootechnical and sanitary characteristics of the animals. It also enabled us to assess farmers' knowledge of brucellosis and risk behaviours.

After the pigs had been restrained by the pig keepers, 4 to 5 ml of blood were drawn from each animal in a dry tube from the cranial vena cava, using a sterile syringe. The tubes were marked with a code based on the animal's details (age, sex, breed, physiological status, farm of origin) and sent under refrigeration to the National Laboratory for Livestock and Animal Health (ENESA) for serum extraction and serological analysis.

Table 1: Number of Pigs Sampled per Village and Commune

Communes	Villages	Number of Pigs	Numbers
Saaba	Nagrin	10	21
	Mogdin	6	
	Baanogo	5	
Pabre	Saint- Joseph	18	49
	Pabre	10	
	Koankin	5	
	Larle Weogo	2	
	Bilgo	4	
	Suag Wiowiongo	10	
Koubri	Kougri	8	43
	Kouba	20	
	Tiibin	8	
	Mougounghin	5	
	Napagtenga Goughin	2	
Ouagadougou	Kamboinsin	9	46
	Bissiguin	3	
	Bendatoega	4	
	Kilwin	7	
	Yagma	18	
	Arrondissement	5	
Komsilga	Kossoguin	12	25
	Bassoyam	6	
	Ponsmtenga	7	
Total	**23**		**184**

Serological analysis

Sera were analyzed by indirect ELISA using the i-ELISA kit (ID-Screen Brucellosis Serum Indirect Multi-species, ID VET, product code BRUS-MS-1014, Gabrels France).

RESULTS

Socio-Demographic Characteristics of Pig Farmers in Kadiogo Province, Burkina-Faso

Pig farming is practiced mainly by men (77.27%) in the 32 to 76 age bracket, with an average age of 50. More than half of the farmers surveyed are educated (62.9%), compared with 25.9% who are illiterate. In order of importance, breeders' level of education was higher (9), secondary (3) and primary (3). Of the pig farmers surveyed, 81.8% were in the private sector, where pig farming was a secondary activity, with experience ranging from 1 to 20 years. Pig farms in the Ouagadougou commune were older operations, while those in other communes on the outskirts were younger. The pig breeds raised were local breeds (68.18%) and crossbreeds (31.82%). Semi-intensive farming predominates (45.5%). In 81.8% of the pig farms visited, other animal species such as cattle, sheep and poultry were found on 9, 9 and 15 of the farms respectively.

Risky Breeder Behavior and Practices

The majority (95.45%) of pig farms encounter pathologies, and 76.19% call in veterinarians. 54.5% of farmers claim to clean their barns daily, but in 95.45% of cases without disinfectant. In the vast majority of pig farms (81.8%, 86.4%), respectively, the introduction of new animals and the loaning of breeding stock for cross-breeding are carried out without respecting quarantine measures. Breeders claim to have encountered cases of sterility (27.3%), abortion (68.2%), emaciation (36.4%) and orchitis (9.09%) on at least one occasion. In the event of abortion, 7% of breeders dispose of the runts in the open air, 20% incinerate them and 73% bury them. The majority of farmers (90.9%) are in permanent contact with the pigs, and some live on the farms (40.9%). Only 50% of farmers have a minimum of protection when they come into contact with the animals. Gloves were worn by 36.4% of farmers when in contact with an aborted sow (59%) and when handling runts (50%).

All the farmers surveyed eat pork, and 13.6% of them claim to have eaten poorly cooked pork. Brucellosis, and its zoonotic nature, is a disease known to only 18.2% of the farmers surveyed, but none of them have annual brucellosis screening despite the high level of education (40.7%) of most farmers.

Seroprevalence of Swine Brucellosis in Kadiogo province in Burkina Faso

Overall Seroprevalence of Porcine Brucellosis

After reading the results, out of 184 sera analyzed in the laboratory, 44 sera were positive for the iELISA test. Thus, the seroprevalence of brucellosis in pigs collected in Kadiogo province was estimated to be 23.9% CI 95% [18.7; 29.1].

Seroprevalence of Swine Brucellosis by Municipality

The highest prevalence rate was recorded in the commune of Pabré, followed by the communes of Komsilga, Ouagadougou, Saaba and Koubri respectively **(Figure 2).** Some villages are more affected in the communes surveyed **(Figure 3).**

Journal of Animal Health
ISSN 2709-5517(Online)
Vol.4, Issue 1, No. 1 pp 1-13, 2024
www.iprjb.org

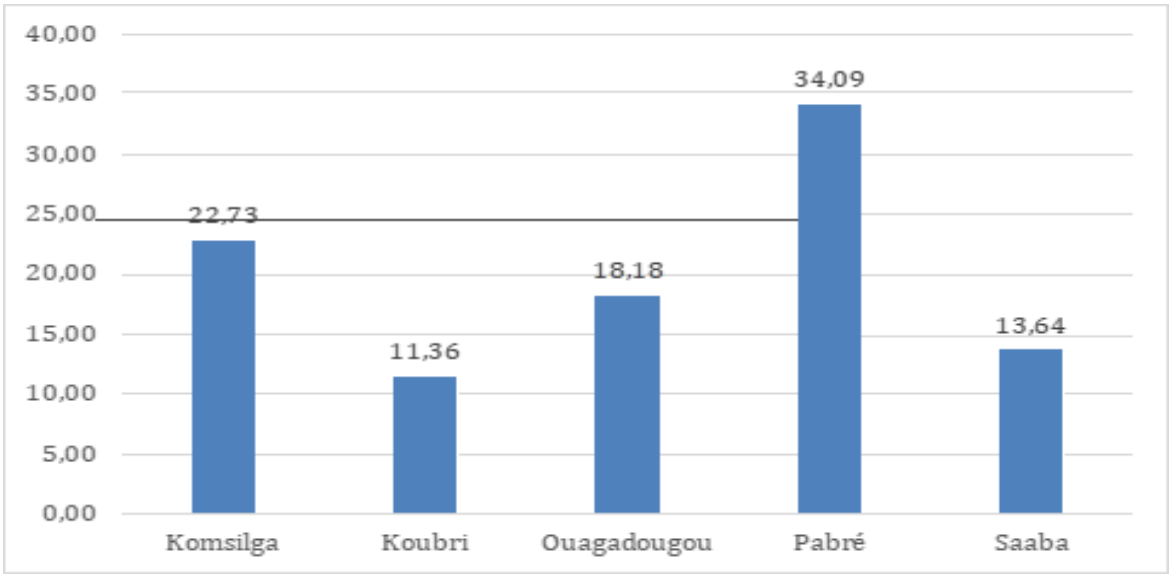

Figure 2: Seroprevalence of Porcine Brucellosis by Municipality Surveyed

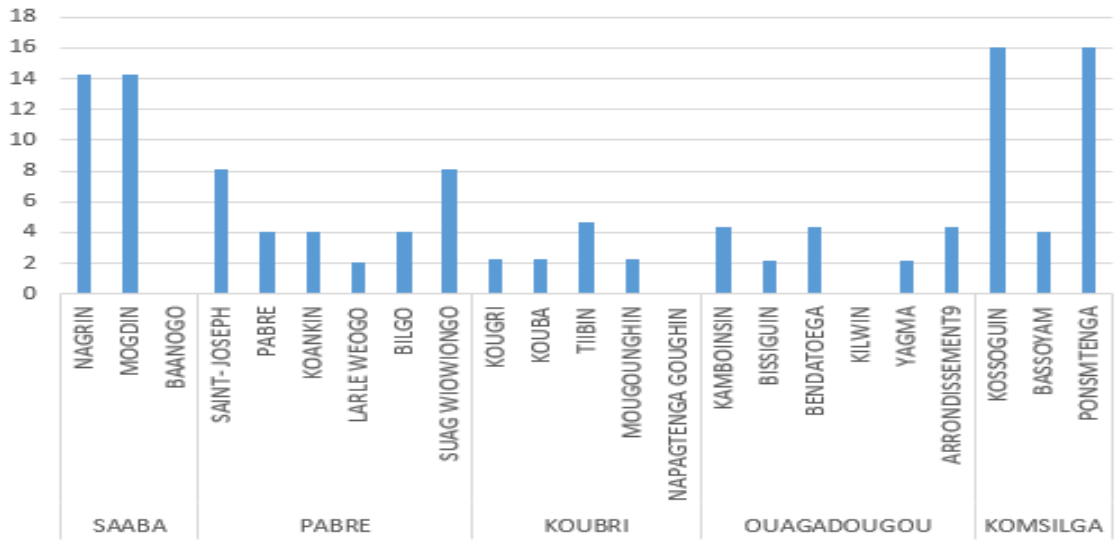

Figure 3: Seroprevalence of Swine Brucellosis by Village in the Communes Surveyed

Seroprevalence of Porcine Brucellosis by Sex

The seroprevalence of porcine brucellosis is significantly associated with sex with a higher prevalence in females than in males (Table 2).

Table I2: Seroprevalence of Porcine Brucellosis by Sex

Variables	Pigs Tested	Positives	Prévalence (%)	95% CI	p-value
Mâle	60	13	21,7	[16,6 ; 26,8]	0,04
Femelle	124	31	25	[21,2 ; 28,8]	
Total	**184**	**44**	**23,9**	**[18,7 ; 29,1]**	

Seroprevalence of Swine Brucellosis by Age

The seroprevalence of porcine brucellosis is associated with age with a significantly higher prevalence in animals over one year of age **(Table 3).**

Table 3: Seroprevalence of Swine Brucellosis by Age

Variables	Pigs Tested	Positives	Prévalence (%)	95% CI	p-value
[0-1 an]	95	19	20	[15,2 ; 24,8]	0,03
> 1 an	89	25	28,1	[24,3 ; 31,9]	
Total	184	44	23,9	[18,7 ; 29,1]	

Seroprevalence of Swine Brucellosis by Breed

The seroprevalence of porcine brucellosis is associated with breed with a significantly higher prevalence in exotic breed pigs **(Table 4).**

Table 4: Seroprevalence of Porcine Brucellosis by Breed

Variables	Pigs Tested	Positives	Prévalence (%)	95% CI	p-value
Locale	42	8	19	[14,6 ; 23,4]	0,04
Exotique	142	36	25,4	[21,2 ; 29,6]	
Total	184	44	23,9	[18,7 ; 29,1]	

Discussion

Socio-Demographic Characteristics of Pig Farmers in the Province of Kadiogo in Burkina Faso

The majority of pig farm owners (81.5%) are men in the age group between 32 and 76 years. These results are similar to those obtained in Benin, Côte d'Ivoire, Congo Brazzaville respectively by Djimenou and Koudande, 2017, Brou et al., 2020, Miassangoumouka and Banga-Mboko, 2019. Indeed, pig farming is considered a subsistence activity (Sagbadja, 2017; Ossebi et al., 2019) but also an investment to prepare for retirement. Traditional and improved systems are the most encountered and the mixed breed is the most exploited against the local breed in Benin (Sagbadja, 2017) and Senegal (Ossebi et al., 2019).

Most of the farmers surveyed are educated, with the study being carried out in the province of Kadiogo, where Ouagadougou, the political capital of Burkina Faso, is located, which has a high demand for pigmeat. The vast majority of farmers associate pig farming with other species with poultry (55.6%) in order of importance, particularly chickens, cattle (33.3%), sheep (33.3%) (Brou et al., 2020) in Korhogo (Côte d'Ivoire). Biosecurity measures are rarely practiced. The majority of pig farms (77.8%) are confronted with pathologies due to the lack of a prophylaxis programme, poor hygiene practices (cleaning and disinfection) linked to the poor quality of the floor of the buildings in the majority of farms (Adoho et al., 2021). The difficulty of feeding forces farmers to leave animals wandering, a major risk factor for the contamination of farms and the spread of diseases (Youssao et al., 2008, Khan et al., 2019).

The majority (66.7%) of breeders do not comply with quarantine when new animals are introduced and 11.1% make loans to breeding stock for breed misbreeding without respecting quarantine. Cases of infertility (22.2%) and abortion (51.9%) were reported, symptoms of suspected brucellosis (Djangwani et al., 2021; Abdulrahman et al., 2022). Abortion is managed by landfilling (44.4%), incineration (11.1%) or release into the environment (3.7%). According to Hebano (2013), abortions and placentas are left on farms or given to carnivores.

Mismanagement of abortions is a major source of contamination. The main transmission of animal brucellosis is the expulsion of fetal tissue, placental tissue and associated fluids expelled during abortions (Akakpo and Ndour, 2013; Hull and Schumaker, 2018). Females infected with brucellosis can excrete high concentrations of the pathogen in their milk, placental membranes and abortions, thus promoting the transmission of the disease to healthy animals and humans (Miassangoumouka and Banga-Mboko, 2019).

Risky Behaviours and Practices of Surveyed Herders in the Province of Kadiogo in Burkina Faso

Brucellosis is known by only 14.8% of the farmers surveyed (knowledge and zoonotic nature) but none of them do annual screening.

The majority (74.1%) of farmers are in constant contact with pigs. Only 40.7% of farmers protect themselves when they come into contact with pigs. Farmers (48.1%) had once been in contact with an aborted sow and 40.7% had once handled the aborted sows. Only 25.9% of breeders used gloves when handling abortions. Human infection with brucellosis usually results from direct contact with tissues or blood of infected animals or from the consumption of contaminated animal products (Tabet-derraz and Bestaoui, 2012; Worth Calfee & Wendling, 2012; de Figueiredo et al., 2015; Rebollada-Merino et al., 2022). Direct contact with infected animals or contaminated products is the main cause of human HIV status (Njeru et al., 2016; Yahiatene, 2021). 33.3% of livestock farmers (workers) living on the farm, the human-animal cohabitation situation would constitute a potential risk factor for disease transmission (Tuon et al., 2017).

Seroprevalence and Factors Associated with Swine Brucellosis in Kadiogo Province in Burkina Faso

The overall seroprevalence of 23.9% is higher than those obtained by Tialla in 2021 in Bobo-Dioulasso (7.7%), 11.86% by Miassangoumouka et al. in Congo Brazzaville in 2019, 0.42-3.07% by Kamga et al. in 2020 in Cameroon. A retrospective study by Gong et al. in 2021 in South America, the European Union, and China recorded prevalences of 9%, 22.7%, and 10%, respectively. On the other hand, higher prevalences were obtained by Pilo et al in 2015 in Sardinia (33%) and by Shome et al., 2019 in India (41.04%) in feral pigs where seroprevalences were significantly higher than in domestic pigs.

Compared to risk factors, individual brucellosis prevalence is correlated with some intrinsic factors such as gender, age, and race.

The seroprevalence of brucellosis is significantly higher in sows contrary to the results obtained by Miassangoumouka and Banga-Mboko, 2019; Chimana et al 2010, Jeffrey et al., 2013) with higher prevalences in boars.

Animals over one year of age (25%) were significantly more infected than those under one year of age (19%). This is justified by the fact that they are more exposed with a high risk of developing the disease with age and reproduction.

Exotic breed pigs were significantly more infected (25.4%) than local breeds (19%). These results are consistent with those of Bronner *et al.* (2010) and Garin-bastuji *et al.* (2010), Miassangoumouka *et al.* (2019).

In intensive breeding of exotic breeds, where all animals are confined, the risk of brucellosis transmission is generally higher. Animals become infected by contact, secretions or inhalation

and the warm and humid environment of the building is also favourable for *Brucella to multiply*.

CONCLUSION AND RECOMMENDATIONS

This study confirmed the presence of swine brucellosis in the Kadiogo province of Burkina Faso, with an overall seroprevalence of 23.9%, identifying significant risk factors such as age, sex, and breed of pigs. The findings also highlighted the potential public health risks for those exposed to infected animals, exacerbated by poor biosecurity practices and limited awareness among farmers regarding the zoonotic nature of the disease. These results underscore the importance of addressing gaps in knowledge and management practices to reduce the spread of swine brucellosis and its transmission to humans.

In light of these findings, it is crucial to strengthen awareness and training programs to educate farmers on the risks of zoonotic transmission and the implementation of biosecurity measures. Regular health screenings, improved hygiene practices, and the use of protective equipment when handling pigs are vital to reducing transmission. At the policy level, stronger disease surveillance and stricter farm regulations are necessary, along with a One Health approach to integrate human, animal, and environmental health efforts.

Acknowledgments

The authors would like to thank the breeders and veterinarians of the Kadiogo province. They would also like to thank the staff of the Microbiology, Epidemiology, Zoonoses and One Health Laboratory in Burkina Faso and the Medical Pathology, Anatomy Pathology and Ambulance Clinic Service at EISMV in Dakar.

Funding Sources

The project was financed by the company's own funds, with support from EISMV in Dakar.

Conflicts of Interest

We have no conflict of interest to disclose.

Declarations

The study was approved by the ethics and research committee of the EISMV in Dakar, and an official letter of contact was sent to breeders and various officials of the province's public veterinary admnistration. Prior to data collection, informants' consent was obtained by explaining the purpose of the study during brief group discussions with the healers.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author, Mireille Catherine KADJA, upon reasonable request.

RÉFÉRENCES

1. Abdulrahman H. A., Sleman, R., Muhamad F. Et Dyary H., (2022). Brucellosis: virulence factors, pathogenicity and treatment. *Animal Health Perspectives,* Vol. 2,103-111 pages.
2. Adoho A. C. C., Olounlade P. A., Azando E. V. B., Hounzangbe-Adote S. Et Gbangboche A. B., (2021). Importances zootechniques et parasites internes des porcs de race locale (*Sus crofa domesticus*) élevés au Bénin : synthèse bibliographique. *International Journal of Biological and Chemical Sciences, 15*(4), 1698– 1716 pages.
3. Akakpo A.J. *et* Ndour A.P.N., 2013. La brucellose bovine en Afrique de l'Ouest et du Centre : état des lieux. *Rev. Afr. Santé Prod. Anim*., 11: pp 23-28.
4. Al-Anif., Al Ghenaimi S., Hussein E., Al Mawly J., Al Mushaiki K. et al Kathery S., (2023). Human and animal brucellosis in the Sultanate of Oman: an epidemiological study. *Journal of Infection in Developing Countries, 17*(1), 52–58 pages.
5. Boukary A. R., Saegerman C., Adehossi E., Matthys F., Vias G. F., Yenikoye A. Et Thys E., (2014). La brucellose en Afrique subsaharienne. *Annales de Médecine vétérinaire*, vol.158, 39–56 pages.
6. Brier J., et Lia Dwi Jayanti. (2020). Brucellosis *(Brucella abortus, Brucella melitensis, Brucella suis). 21*(1), 355–398 pages.
7. Bronner A., Garin-Bastuji, B., (2010). *Bilan de la surveillance de la brucellose porcine en 2009 : détection de foyers sporadiques en élevage plein air. 1,* 32–34 pages.
8. Brou G. K. G., Adou C. F. D., Meniga M. et Soro R. Y., (2020). Characterization of Pig Farms in the Department of Korhogo Caracterisation Des Elevages Porcins Dans Le Departement De Korhogo. *Journal of Applied Science and Environmental Studies JASES, 3*(3), 183– 198 pages.
9. De Figueiredo P., Ficht T. A., Rice-Ficht A., Rossetti C. et Adams L. G. (2015A). Pathogenesis and immunobiology of brucellosis: Review of *Brucella*-host interactions. *American Journal of Pathology, 185*(6), 1505–1517 pages.
10. Diaz Aparicio E. (2013). Epidemiology of brucellosis in domestic animals caused by *Brucella melitensis*, *Brucella suis* and *Brucella abortus*. *OIE Revue Scientifique et Technique, 32*(1), 43–60 pages.
11. Djangwani J., Ooko Abong' G., Gicuku Njue L. et Kaindi D. W. M., (2021). Brucellosis: Prevalence with reference to East African community countries – A rapid review. *Veterinary Medicine and Science, 7*(3), 851–867 pages.
12. Djimenou D. et Koudande D. O., (2017). Socio-demographic characteristics of pig producers and structure of pig herd in South of Benin. *International Journal of Biological and Chemical Sciences, 11*, 2177–2193 pages.
13. Ducrotoy M., Bertu W. J., Matope G., Cadmus S., Conde-Álvarez R., Gusi A. M., Welburn S., Ocholi R., Blasco J. M. et Moriyon I., (2017). Brucellosis in Sub-Saharan Africa: Current challenges for management, diagnosis and control. *Acta Tropica, 165*, 179–193 pages.
14. FAO., 2012. Secteur porcin au Burkina Faso. FAO, 83p. Guinko.

15. Glowacka P., Zakowska D., Naylor K., Niemcewicz M. Et Bielawska-Drozd A., (2018). *Brucella* – Virulence factors, pathogenesis and treatment. *Polish Journal of Microbiology*, *67*(2), 151– 161 pages.
16. Gong Q. L., Sun Y. H., Yang, Y., Zhao B., Wang Q., Li J. M., Ge G. Y., Chen Z. Y., Shi K., Leng X., Zong Y. et Du R., (2021). Global Comprehensive Literature Review and Meta-Analysis of *Brucella spp*. in Swine Based on Publications From 2000 to 2020. *Frontiers in Veterinary Science*, vol *8*, 630-960 pages
17. Hebano H. A., (2013). Etude Sero-Epidemiologique de La Brucellose Animale Dans La Republique De Djibouti. N° 20, UNIVERSITE CHEIKH ANTA DIOP DE DAKAR, Dakar, Senegal, 101 pages.
18. Hull N. C. et Schumaker B. A., (2018). Comparisons of brucellosis between human and veterinary medicine. *Infection Ecology and Epidemiology*, *8*(1), 1500846 pages.
19. Jamil T., Akar K., Erdenlig S., Murugaiyan J., Sandalakis V., Boukouvala E., Psaroulaki A., Melzer F., Neubauer H. et Wareth G., (2022). Spatio-Temporal Distribution of Brucellosis in European Terrestrial and Marine Wildlife Species and Its Regional Implications. *Microorganisms*, *10*(10), 1970 pages.
20. Jeffrey M. B. Musser, Andy L., Schwartz Indumathi Srinath and Kenneth A. Waldrup, 2013. Use of serology and bacterial culture to determine prevalence of brucella spp. In feral swine (sus scrofa) in proximity to a beef cattle herd positive for brucella suis and brucella abortus. *Journal of Wildlife Diseases*, 49(2), pp. 215–220
21. Kamga R. M. N., Silatsa B. A., Farikou O., Kuiate J. R. et Simo G., (2020). Detection of *Brucella* antibodies in domestic animals of southern Cameroon: Implications for the control of brucellosis. *Veterinary Medicine and Science*, *6*(3), 410–420 pages.
22. Kansiime C., Mugisha A., Makumbi F., Mugisha S., Rwego B I., Sempa J., Kiwanuka S. N, Asiimwe B. B and Rutebemberwa E., 2014. Knowledge and perceptions of brucellosis in the pastoral communities adjacent to Lake Mburo National Park, Uganda. BMC Public Health, 14: 11p
23. Khan A. U., Melzer F., El-Soally S. A. G. E., Elschner M. C., Mohamed S. A., Ahmed M. A. S., Roesler U. et Neubauer H., El-Adawy H., (2019). Serological and molecular identification of *Brucella spp*. In pigs from Cairo and Giza governorates, Egypt. *Pathogens*, *8*(4), 1–7 pages.
24. Kiendrébéogo T, Hamadou S, Mopate L. Y et Kabore Zoungrana C-Y., 2008. Typologie des élevages porcins urbains et périurbains de Bobo -Dioulasso (Burkina Faso). *Revue Africaine de Santé et de Productions Animales. RASPA*, 2008, Vo1.6, N°3-4, 200- 212 pages.
25. Kurmanov B., Zincke D., Su W., Hadfield T. L., Aikimbayev A., Karibayev T., Berdikulov M., Orynbayev M., Nikolich M. P. Et Blackburn J. K., (2022A). Assays for Identification and Differentiation of *Brucella* Species: A Review. *Microorganisms*, *10*(8), 1–23 pages.
26. Li F., Du L., Zhen H., Li M., An S., Fan W., Yan Y., Zhao M., Han X., Li Z., Yang H., Zhang C., Guo C. et Zhen Q., (2023). Follow-up outcomes of asymptomatic brucellosis: a systematic review and meta-analysis. Emerging Microbes & Infections, 12(1), 2185464 pages.

27. Miassangoumouka J. P. et Banga-Mboko A. I. H., (2019). Dépistage sérologique de la brucellose porcine et analyse des facteurs de risques dans les élevages à Brazzaville, République du Congo. 42(1), 7127–7138 pages.
28. Ministere De La Sante Burkina Faso (DGESS). (2020). Annuaire statistique 2020. *Annuaire Statistiaue 2018*, 478. Extrait de https://www.sante.gov.bf/fileadmin/user_upload/storages/annuaire_statistique_ms_2020_signe.
29. Mopate Ly, Kabore-Zoungrana Cy. et Facho B . 2011a. Structure des troupeaux et performances des élevages porcins de la zone de N'Djaména au Tchad. International Journal of Biological and Chemical Science 5 : 321-330.
30. Mopate Ly, Koussou Mo, Nguertoum Ea, Ngo Tama Ac, Lakouetene T, Awa Dn. et Mal He : 2010. Caractéristiques et performances des élevages porcins urbains et périurbains des savanes d'Afrique centrale : cas des villes de Garoua, Pala et Bangui. Actes du colloque « Savanes africaines en développement : innover pour durer », 20-23 avril 2009, Garoua, Cameroun.
31. Nielsen K. et Yu W. L., (2010). Serological diagnosis of brucellosis. *Prilozi / Makedonska Akademija Na Naukite i Umetnostite, Oddelenie Za Biološki i Medicinski Nauki = Contributions / Macedonian Academy of Sciences and Arts, Section of Biological and Medical Sciences*, *31*(1), 65– 89 pages.
32. Olsen S. C., Boggiatto P., Nol P. et Samartino L., (2019). Diseases of swine, 10 ème édition, 778–791 pages.
33. Olsen S. et Tatum F., (2016). Swine brucellosis: current perspectives. *Veterinary Medicine: Research and Reports*, *Volume 8*, 1–12 pages.
34. Ossebi W., Ayssiwede S. B., Nimbona F., Malou R., Djettin A. E., Diop M., et Missohou A., (2019). Analyse zootechnique et économique des systèmes d'élevage de porcs en Casamance (Sénégal). *Revue d'élevage et de Médecine Vétérinaire Des Pays Tropicaux*, *72*(1), 13 pages.
35. Pilo C., Tedde M. T., Orru G., Addis G. et Liciardi M., (2015). *Brucella suis* infection in domestic pigs in Sardinia (Italy). *Epidemiology and Infection*, *143*(10), 2170–2177 pages.
36. Rebollada-Merino A., Perez-Sancho M., Rodriguez-Bertos A., Garcia1 N., Martinez I., Navarro A., Dominguez L. et Garcia-Seco T., 2022. Environment and Offspring Surveillance in Porcine Brucellosis. Frontiers in Veterinary Science June 2022 | Volume 9 | Article 915692.
37. SagbadjA, A. (2017). *Machine Translated by Google Papier original Caractéristiques sociodémographiques des éleveurs de porcs (Sus Scrofa domesticus) et structure du cheptel porcin au Sud du Bénin*
38. Sehi A. T. B., (2019). Les zoonoses : un risque sanitaire en milieu rural dans la Sous-préfecture de Korhogo (Côte d'Ivoire). *Espace Géographique et Société Marocaine*, *30*, 13–37 pages.
39. Shome R., Kalleshamurthy T., Natesan K., Jayaprakash K. R., Byrareddy K., Mohandoss N., Sahay S., Shome B. R., Hiremath J., Rahman H. et Barbuddhe, S. B., (2019). Serological and molecular analysis for brucellosis in selected swine herds from Southern India. *Journal of Infection and Public Health*, *12*(2), 247–251 pages.

40. Tabet-Derraz, N., et Bestaoui, S. (2012). Epidémiologie et clinique de la brucellose humaine sur trois décennies en zone endémique. *13 Èmes Journées Nationales d'Infectiologie*, *1*.

41. Tialla D. (2021). Seroprevalence and behaviour at risk of zoonotic transmission of bovine brucellosis in Namentenga Province, Burkina Faso. *African Journal of Microbiology Research*, *15*(11), 547–553 pages.

42. Tialla, D. ; Zio, A. C. ; Yameogo, I. G. ; Cisse, A. ; Sagna, T. ; Ilboudo, A. K. ; Sanou, M. A. ; Kouanda, S. ; Ouedraogo, G. A. ; Tarnagda, Z. (2018). *SÉRO-ÉPIDÉMIOLOGIE DE LA BRUCELLOSE BOVINE ET PORCINE*. 175–179 pages

43. Worth Calfee M. et Wendling M., (2012). The effects of environmental conditions on persistence and inactivation of *Brucella suis* on building material surfaces. *Letters in Applied Microbiology*, *54*(6), 504– 510 pages.

44. Yahiatene I., (2021). Facteurs de risque liés à la transmission de la brucellose animale et humaine en Algérie. Institut des Sciences Vétérinaires- Blida. Algérie. 54 pages

45. Youssao Ak I, Koutinhouin Gb, Kpodekon Tm, Bonou Ag, Adjakpa A, Dotcho Cdg, Atodjinou FTR : 2008. Production porcine et ressources génétiques locales en zone périurbaine de Cotonou et d'Abomey-Calavi au Bénin. Revue d'Élevage et de Médecine vétérinaire des Pays tropicaux 61 : 235-243.