Infectious and Parasitic Diseases of Pigs in Ecuador: A Literary Review

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Abstract

The intensive pig production to meet the demand for food of animal origin has led to an increase in the presentation of different pig diseases. The threat of epidemic and emerging diseases affecting pigs, which in some cases are zoonotic, highlights the vulnerability of pig production worldwide. Groups of diseases such as the respiratory complex and diseases caused by porcine coronaviruses represent serious health problems in Ecuador. However, even though vaccination for several of these diseases is available, it is necessary to know the circulating strains and the responses to vaccination to improve health control programs. The present study aims to analyze the epidemiological surveillance information available through a systematic review of various diseases that affect pigs. In Ecuador, there is Little epidemiological surveillance of diseases such as porcine epidemic diarrhea, Mycoplasma hyopneumoniae, cysticercosis and helminthiasis, which present zoonotic potential and deteriorate economic production rates. In conclusion, the research reflects the need to know the prevalence and incidence of swine diseases circulating in the country to guarantee food safety and economic efficiency in the swine industry.

Keywords: *Ecuador, diseases, parasites, swine production, zoonosis, zoonosis.*

1. Introduction

Livestock production in 2022 faces multiple challenges, including the need to produce more food to meet the needs of a fast-growing population through efficient methods that guarantee their environmental, social, economic and public health sustainability. Recent reports from United Nations [1] estimate a 24% population growth by the year 2050 (9.8%), thus implying a greater need and consumption of food, particularly of animal origin. Due to its nutritional qualities, as well as production and acquisition costs. One of the main reasons for products is chicken and pork. In fact, pork accounts for over one-third of the world's total meat production and is an important component of food security, economy and trade [2]. In Ecuador, it is estimated that the consumption of pork in 2016 was 10 kg per person a year [3]. Data from the last agricultural census shows that swine production as of 2017 was 1,115.43 animals, centralized in the Coast and Sierra regions [3]. This intense demand for pork production in Ecuador and worldwide has led to an intensification of production, maintaining high levels of ideal densities for the rapid transmission of pathogens that affect animal health and represent a serious risk to public health [4].

Under this scenario, meat production in Ecuador's swine industry must guarantee high animal health standards that ensure the innocuousness of the pigs (good living) and expand its international trade. Infectious diseases directly result in losses in livestock production due to the loss of mortality, loss of production rates, trade restrictions, reduced market value, and food insecurity [5]. The constant threat of endemic and emerging diseases that affect pigs, which in some cases also affect human health, highlights the vulnerability of the pigs to the potential of swine production worldwide. The intensification and globalization of the industry have contributed to the emergence and global spread of swine pathogens, driven partly due to the frequent movement of pigs, feed and pork products locally, nationally and internationally [6].

A clear example is the porcine epidemic diarrhea virus (PEDv), which in one year spread from China to the United States, affecting 50% of the farms and causing the death of at least 7 million piglets [7]. However, the potential importance of the pathogens in the public health impact of swine was evidenced during the H1N1 "swine flu" pandemic in 2009, which originated from influenza A viruses that were circulating in the populations of pigs [8]. Thus, there is a compelling need to build a holistic global picture of pathogens of pigs to improve preparedness and understand patterns of emergence and spread in the country and worldwide.

The purpose of this research is to evaluate the research propensities through a literature review on the main swine pathogens in Ecuador that will allow to identify national and Latin American research priorities.

2. Methodology

Overall, 19 publications from 1998 to 2022 were included in this analysis, based on searches for various swine pathogens (LatinIndex, PubMed, Web of Science and Scopus). In addition, due to the scarcity of information, several research projects from repositories of different universities in Ecuador were included. Using computer-assisted annotation, these pathogens were selected within the most published swine infectious agents worldwide. Computer of bioconcepts (i.e., organisms and diseases) were found in the abstracts from PubMed [9], considering also the reports of the Organization for Animal Health (OIE). The viruses of the highest health reports included Influenza, Pseudorabies (Aujeszky's disease), Circovirus type 2 (CPV2), Porcine Epidemic Diarrhea (PED), Transmissible Gastroenteritis (TGE), Porcine Epidemic Syndrome (PES) (PRRS), Classical Swine Fever (CSF), African Swine Fever (ASF). Bacteria of major sanitary importance included Actinobacillus pleuropneumoniae (APP), Salmonella, spp., Bordetella bronchiseptica, Pasteurella multocida, and Mycoplasma hyopneumoniae. At The parasitic agents were A. suum, Strongyloides ransomi, Hyostrongylus spp, Oesophagostomun spp, Trichuris suis, Macracanthorhynchus hirudinaceus, Mestastrongylus spp, Mestastrongylus stefanurus, and Cysticercus / T. solium.

3. Development and Discussion

In general, the information available on swine diseases initially raised in This bibliographic review has proved to be scarce. Thus, it has not been possible to gather information about the presence of microbial agents such as swine influenza virus, Actinobacillus pleuropneumoniae, Bordetella bronchiseptica and Pasteurella multocida. Therefore, these agents have been omitted from this analysis. Similarly, porcine helminthiases have been poorly described so this work refers to prevalence studies without emphasizing the nature of the parasitic infestations. In addition, the studies carried out in the country that refer to the zoonotic potential of parasites such as A. suum or T. suis have been included.

3.1. Porcine respiratory complex

Respiratory diseases are one of the main causes of production losses in swine farms [10]. A multifactorial disease is referred to as the porcine respiratory complex caused mainly by the interaction of bacterial and viral pathogens, which, in addition, are influenced by environmental and management stressors [11]. Microbial agents can act as both primary and secondary pathogens, so their pathogenesis is considered diverse. Under commercial conditions, it is considered that the presentation of the complex respiratory system is primarily related to a viral attack that subsequently promotes a secondary bacterial infection [10]. As part of the primary viral pathogens may act viruses like porcine reproductive and respiratory syndrome, porcine circovirus type 2, swine influenza virus, pseudorabies virus (Aujeszky's) and porcine respiratory coronavirus. While as agents, Mycoplasma hyopneumoniae, Pasteurella multocida, Streptococcus suis, and Actinobacillus pleuro pneumoniae (11). Among these, the information available in Ecuador is detailed as follows.

3.1.1. Enzootic pneumonia: Mycoplasma hyopneumoniae

Enzootic pneumonia is one of the most prevalent respiratory diseases affecting pigs worldwide. Its etiology corresponds to Mycoplasma hyopneumoniae, a bacterium gram-negative, which lacks a cell wall and is, therefore, not sensitive to antibiotics that act on the cell wall, such as β-lactams [11]. As part of its pathogenesis, it is capable of adhering to the cilia of the epithelium of the middle and lower respiratory tract, damages the hair cells of the trachea, bronchi and bronchioles, and suppresses the immune response of the upper respiratory tract that favors the development of secondary pathogens [11]. As mentioned above, M. hyopneumoniae is one of the most common secondary pathogens [11] involved in the swine respiratory complex in synergy with other agents bacterial as Streptococcus suis, Bordetella bronchiseptica and Pasteurella multocida and viral as PRRS, Influenza, Aujeszky's disease and swine circovirus [11]. Certain epidemiological aspects, such as the persistence and genetic diversity of M. hyopneumoniae strains circulating within herds, have been addressed in some studies worldwide and Latin America in countries such as Mexico [12], Argentina [13], Colombia [14], Peru [15], Cuba [16,17], United States, Brazil, Mexico and Spain [18,19].

Concerning Ecuador, little research has been developed on enzootic pneumonia and CRP. Through short-range research work, such as undergraduate research. The presence of the disease has been determined in provinces such as Chimborazo [20] and El Oro [21]. However, although vaccination to control enzootic pneumonia in Ecuador is available, an in-depth research is needed to understand the circulating strains and the adequate or inadequate response to commercial vaccines available under local production conditions.

3.2. Porcine Respiratory Reproductive Syndrome (PRRS)

Porcine Reproductive and Respiratory Syndrome (PRRS) is a viral disease of the porcine reproductive tract characterized by two overlapping clinical presentations: on the one hand, reproductive failure in the respiratory presentation in pigs of any age has been reported. On the other hand, it has been reported that there is 10 to 20% morbidity in adult pigs and up to 100% mortality in piglets, especially those affected by the highly pathogenic Chinese strain [22]. In the late 1980s, only a few countries reported the presence of the virus, but it is now present in most of the world's countries involved in swine farming. The etiologic agent is confined to an RNA-stranded virus simple positive sense with an envelope belonging to the order Nidovirals of the family Arteriviridae, genus Arterivirus [23]. In Ecuador, the first official outbreak reported to the OIE [24] was in a farm [24] in the province of Santo Domingo de los Tsáchilas, with 469 susceptible animals, of which 7 cases were positive. From this point on, the disease is circulating in the farms. However, no research has been carried out in this area in the country. Neighboring countries, such as Peru and Colombia, have been declared endemic. In fact, in Colombia, the virus has been isolated in 14 out of 32 departments analyzed [25].

Similarly, in Peru, the virus has been isolated from populations in Lima and Arequipa [26]. Other countries, such as Chile and Mexico, have also reported the presence of swine in the disease [27,28]. The presence of the disease has been responsible for economic losses of up to 10% in piglets per year and up to $300 per sow per year [25,29]. Considering the narrow Ecuador's geographic, social and commercial relationship with Colombia and Peru, monitoring the pathogen is essential to understanding and zone the presence of the disease.

3.3. Porcine Multiple Systemic Culling Syndrome (PCV2)

Report of markedly stunted pigs in Canada led to virus isolation classified in the family Circoviridae, genus Circovirus, later named Circovirus of Porcine type 2 [30]. It is considered a ubiquitous virus of worldwide distribution whose signology is characterized by weight loss, poor body condition, diarrhea, weakness, jaundice, lymphadenopathy, and problems with respiratory infections unresponsive to antibiotic treatment. In Latin America, its presence has been reported in countries such as Venezuela [31], Chile [32], Colombia [33,34], Brazil [35], Argentina [36], and Ecuador [37]. In Ecuador, the first and only report of PCV2 was made by sampling 162 animals (commercial farm and slaughterhouse) from November 2010 to March 2011.

Samples were analyzed from each animal's lymph nodes, lung, liver, spleen and kidney. From PCV2 DNA was detected in 62% of samples, a rate similar to that reported in Brazil (70%). [38, 39]. Nevertheless, it should also be considered that studies have found positive animals (ELISA and PCR) despite not showing clinical signs, suggesting the subclinical presence of infections [33]. The latter reiterates the need to establish active surveillance programs that the results of this study will allow s to elucidate the dynamics of infection in Ecuador to establish sanitary control measures.

3.4. Porcine coronavirus: Porcine epidemic diarrhea (PED) and gastroenteritis. transmissible (GET)

The pig acts as a natural host for six different species of coronaviruses, among them the swine influenza virus, Porcine epidemic diarrhea (PED) and transmissible gastroenteritis (TGE), both of which are antigenically different. Porcine epidemic diarrhea (PED) is a highly contagious viral disease caused by a coronavirus of RNA of the Alphacoronaviridae family [40]. It was first reported in the United Kingdom in 1971, spreading rapidly in countries in Europe and Asia [40]. In 2013, it was declared for the first time its appearance on the American continent, in the United States. In Latin America, its presence has been declared in countries such as Mexico [41], Peru, Dominican Republic [42], Colombia [34] and Ecuador [39,43].

The virus is characterized by profuse liquid diarrhea of variable intensity, particularly affecting piglets during lactation. In 2014, the first outbreak of PED in Ecuador was confirmed to the OIE in a farm of 10,908 animals in the province of Cotopaxi (San Buenaventura, Latacunga), with 1,341 cases [39]. Despite its great importance and economic impact, the disease has been very little studied in Ecuador, reporting only this first outbreak. The phylogenetic study of the strains isolates revealed genetic similarity to the Chinese DEPv strains that were primarily propagated to the United States in 2013 and from Korea, Canada, Mexico and Ecuador [43]. In this same period, the main imports of live pigs were from Chile and the United States. Therefore, this animal movement has been suggested as the main hypothesis for the mechanism of introduction of the disease to the country.

As for the porcine transmissible gastroenteritis disease’s clinical and pathological signs are very similar to DEPv; therefore, it requires laboratory diagnosis for confirmation. The severity of the disease is linked to the age of the infected animals, and a high infection rate of morbidity and mortality in lactating piglets can be detected [40]. Since the first report of the GETv in the United States in 1946 [40], the virus has spread to several countries. In Latin America, it has been detected in Colombia [44], Venezuela [45], Cuba [46], Panama and Bolivia [47], Mexico, Brazil and Argentina [48]. No cases have been reported in Ecuador; however, this may indicate a deficit in health surveillance rather than the absence of the disease.

3.5. Foodborne Diseases: Salmonellosis

Foodborne illness (FBD) is a syndrome caused by the consumption of food of both animal and vegetable origin containing microbiological agents in sufficient quantities to affect the individual’s health [49]. Among the microbial agents that cause The most frequent ETAs are Salmonella spp, Campylobacter spp, Shiguella spp, among others [50]. Salmonella spp is a widely distributed gram-negative bacillus with great importance in public health due to its zoonotic risk [51]. Salmonellosis is a worldwide foodborne disease where the main cause is the consumption of products of animal origin and plant contamination [49], causing severe disorders in humans and animals, causing digestive problems, fever, dehydration and even death [52]. Some serovars of Salmonella spp. are capable of infecting swine as well as have been linked to outbreaks in humans [52].

Although the disease is subclinical in pigs, its main importance lies in the possible cross-contamination during the slaughter of animals at the slaughterhouse, both carrier pigs as healthy, which will result in zoonosis. For example, monitoring the pathogen on a farm has shown a presence of 8.9% [53] to 49% [54] in countries such as Colombia and Brazil, respectively. On the other hand, the evaluation of the pathogen in pig samples at the time of the sacrifice has shown a presence of 6.3%, 46.8% (carcasses) [55,56], 67% (lymph nodes), 55.9% (lymph nodes), 55.9% (lymph nodes) [55,56] and 55.9% (lymph nodes) [55,56], cecal contents, 44.1% (ileocecal lymph node) [57], 24% (carcasses under cooling) [54] in countries such as Peru, Mexico, Brazil and Argentina.

With respect to Ecuador, the presence of the pathogen has been reported through undergraduate investigations [58,59]. Thus, Salmonella spp. were isolated from 15% (56/365) of the pigs slaughtered at the Empresa Pública Metropolitana de Rastro Quito, based on samples such as cecal contents, mesenteric nodes [58]. On the contrary, an undergraduate investigation conducted in markets in the city of Machala reports the absence of the pathogen, even in markets with poor hygienic conditions [59].

3.6. Classical Swine Fever

Classical swine fever (CSF), also known as hog cholera, is caused by an RNA virus from the genus Pestivirus [60]. It is characterized by its rapid dissemination, high morbidity (90%) and mortality rates in susceptible herds, affecting domestic and wild pigs [61]. Because of its high transmissibility and heavy economic and social losses form part of the list of diseases of compulsory reporting to the OIE. Although the disease has been declared endemic in large parts of the world, it has been controlled and even eradicated in countries in regions such as North America, Central America and Europe. It has been estimated that CFP can cause annual losses of up to 22% million dollars due to mortality, feed efficiency losses and veterinary costs [62]. In Ecuador, since the introduction of the CSF virus in the 1940s, the disease has been declared endemic, which is why one of the most important control and eradication programs has been set up emblematic of the last decade in terms of animal health. Their high morbidity and mortality (40%- 60%) have caused substantial losses to the national industry, particularly in the highlands and coast [63]. As of 2012, AGROCALIDAD recorded 49 notifications of CSF outbreaks, of which 32 were positive, mainly in the provinces of Manabí, Orellana and Sucumbios, Zamora Chinchipe and Guayas [63]. Few studies have been conducted to assess the pathogenicity of a field strain and the usefulness of vaccines for its control [64,65].

3.7. African Swine Fever

African swine fever (ASF) is a viral hemorrhagic disease with extremely high lethality in domestic and wild pigs. Its etiologic agent is the double-stranded DNA virus of the genus Asfivirus family [66]. Although it affects a limited range of hosts and its potential zoonotic is minimal, its social and economic impact is very high. Therefore, the surveillance and control of the clinical signs should be considered similar to those of CSF, which is why it requires laboratory confirmation. Globally, little is known about the genes virulence, host range, and virus-vector-host interaction; therefore, an investigation of further investigation is required. As for the presence of ASF, it has not been reported in the country; however, it has not been reported in the country. However, Latin American reports have reported its presence in the Dominican Republic and Haiti [67].

3.8. Control and eradication plan Classical Swine Fever, African Swine Fever

Considering all of the above, Ecuador implemented a program for the control and monitoring of the eradication of CSF, which consists of five components: zoning and control of outbreaks, training, epidemiological surveillance and diagnosis, vaccination and mobilization control [63].

During the development of this program, 89% of farm animals have been vaccinated. However, for backyard production, the efficacy of the vaccination system is unknown. The insular region is the only national territory that since 2010 has been recognized by the OIE as free of CSF [63]. From the beginning of this program until the year 2021, vaccination and 1,800,062 swine were identified, reducing disease outbreaks to 14 by 2021 [68]. With regard to ASF, although it has not been reported in Ecuadorian territory, AGROCALIDAD border controls by air, land and sea, animal and plant health inspections and verification at international arrivals, customs warehouses and quarantine control of entry into the country and the classification of agricultural products following the requirements of the Health Risk Category. For the attention of a sanitary emergency, three phases are executed: alert, suspicion phase and emergency or confirmation phase to reduce potential risks for disease introduction.

3.9. Swine helminthiasis

Gastrointestinal helminthiases affect pig farms under all systems of animal production husbandry worldwide. Traditional farms are associated with a high level of production with prevalence and parasitic intensity, typically related to Oesophagostomum spp., Hyostrongylus rubidus, Trichostrongylus axei, A. suum and Trichuris suis [69]. Even though in confined pigs, but under the same production system, the parasitic intensity is also high, it is usually restricted to a single species, usually Oesophagostomun spp. in the case of adult pigs and A. suum in the case of piglets [70]. Other genera, such as Hyostrongylus rubidus, or those with an indirect biological cycle (i.e., Metastrongylus spp.) have been recorded sporadically or are absent altogether in confined pigs [71].

On the other hand, A. suum is one of the few species that has even been recorded in highly technical pig farms [70,72]. In Ecuador, the study of porcine gastrointestinal helminthiasis has received little attention. This fact may be related to parasitic diseases' effect on domestic swine. In contrast to ruminants, porcine helminths are rarely associated with clinical diseases, which go unnoticed by pig farmers and veterinarians involved in their control [70]. However, such parasitoses have a subclinical course and can be associated with a reduction in growth rate and feed conversion [73,74].

In addition, due to the biological cycle of parasites such as A. suum or Trichinella spiralis, the producers can face severe economic losses related to the seizure of livers or whole carcasses at slaughter [75,76]. Few studies on the prevalence or intensity of infection have been conducted in the country [75,76]. These include the studies presented in Table 1 [77,78]. In these studies, A. suum is the most prevalent parasite in the swine population analyzed. However, whether the infection is single or multi-etiologic was not detailed. Findings of acanthocephalan parasites have been punctually described [79], without being mentioned as a common problem.

Table 1. Prevalence of gastrointestinal parasites in pigs in Ecuador.

n	Genre	Prevalence (%)	Method	Location
322	*A.suum*	29.29	a	Avocado - Loja
	S. ransomi	26.43		
	Hyostrongylus/Oesophagostomun	7.43		
	T. suis	2.71		
	M. hirudinaceus	0.86		
639	*A. suum*	14.09	b	Francisco de Orellana
	Metastrongylus	2.35		
	Stefanurus	1.88		
	Cysticercus	0		

n: number of animals studied; a: coproparasitological examination, larval culture; b: post-test, larval culture; c: post-test, larval culture; d: post-test, larval culture; e: post-test, larval mortem culture; A. suum: Ascaris suum; S. ransomi; Strongyloides ransomi; T. suis: Trichuris suis; M. hirudinaceus: Macracanthorhynchus hirudinaceus. Source: a [78], b [77].

Undoubtedly, the greatest attention has been focused on parasites of zoonotic interest, such as T. spirales, Taenia solium, T. suis or A. suum. Thus, for example, T. solium is the cause of the cysticercosis teniasis complex in humans [80]. On the one hand, human and porcine cysticercosis occurs when these act as intermediate hosts and consume water or food contaminated with eggs or gravid proglottids.

In order for the adult parasite to develop, humans must consume undercooked pork meat with viable cysticerci [81], thus completing the biological cycle of the parasite when the cysticercus lodges in the brain gives rise to what is known as neurocysticercosis, one of the most common zoonotic diseases produced by the most prevalent cestodes in the world. However, the highest rates are concentrated in countries in Latin America, Africa and Asia, where social, economic and political conditions are cultural factors that favor the maintenance of this zoonosis [82]. Therefore, identifying animals and foodstuffs that are carriers of diseases such as cysticercosis is essential to ensure that the foodstuffs of animal origin are safe for human consumption [76]. Necropsy, for example, is a post-mortem methodology that is quite sensitive when dissecting the carcass. However, the detection of cysticerci during routine inspections may have a low sensitivity (~20%), especially when infections are mild [83,84]. Sensitivity in the detection of disease in swine can increase if they use serological methods such as those based on the identification of antigens or antibodies with enzyme-linked immunosorbent assays (ELISA: Enzyme- Linked Immunoabsorbent Assay) or electro immunoblotting (EITB), reaching sensitivity levels of 85% to 100% [83,85]. Between 1998 and 2003 in Ecuador, between 0 and 0.52% incidences were recorded by means of inspections, and values ranged from 2.12 (Portoviejo) to 12.01% (Ibarra) by ELISA or Electro Immunotransfer.

The blot in Table 2 illustrates that the estimated prevalence of cysticercosis is a function of the methodology used.

Table 2. Incidence of swine cysticercosis in different populations of Ecuador

Year	n	Positives	Prevalence (%)	Method	Location
1998	8154	0	0	a	Quito
1998	1101		0.73	a	
	591		6.76	b	
1999	2471	58	2.34	a	Loja
1999	1795		0.38	a	Ibarra
	441		12.01	b	
	441	0	0	c	
	441		0.45	a	
2000 - 2001	1587		2.88	a	Celica
2001	192		11.4	b	Loja
	192		2.08	a	
2001	861	0	0	a	Portoviejo
	330		2.12	b	

		0	0	a	Ambato
			12.5	b	
2003	1032		9.1	b	Ibarra
	2896		0.52	a	
2006	646		3.56	c	Zapotillo

n: number of animals studied; a: veterinary inspection; b: ELISA; c: animal inspection; d: animal tongue inspection; d: electroimmunoblot.

Source: Adapted from [86].

After 2006, no studies on swine cysticercosis have been published in the country. However, recent studies suggest active foci of infection. In localities such as Loja, the seroprevalence of people with active infections was less than 1%, and the rate of exposure to the parasite was less than 1%, which can reach up to 14% of the total population [87].

Another problem related to the consumption of raw or undercooked pork is related to the following with trichinellosis. Although there are numerous species of Trichinella, T. spiralis is the most common species with zoonotic importance, with domestic swine being the main transmitter of the disease [88- 90]. The control of the host and the meat derived from it is done at many points in the meat production chain, including slaughterhouses [91]. Two of the most commonly used methods consist of searching for the larvae encysted in the muscles, or more sensitive methods, such as antigen or antibody detection using ELISA [92]. In 2005, an investigation was published on the complete trichinosis study in Ecuador's swine [93]. In this research, two techniques were used: serology to determine antibodies and artificial digestion of the muscles of the diaphragm in search of larvae (Table 2). Although artificial digestion did not find evidence of the presence of the parasite in swine, the use of serology helped to determine a prevalence of between 0.35 to 5.75%. However, subsequent studies in 2018 in the Manabí using the technique of artificial muscle digestion did not give any positive results [94,95].

Table 3. Prevalence of porcine trichinosis in several localities of Ecuador.

Year	n	Method	Positives	Prevalence	Location
2000a	2000	a		0.35	Coastal and Andean region - north
2001a	331	a b	0	-	National
			0	-	
2003a	646	a b		5.72	Andean region - south
			0	0	
2018b		b	0	0	Quito
2018c		b	0	0	Rocafuerte - Manabí

n: number of animals studied; a: artificial digestion; b: ELISA a[93], b[95], c[96].

Finally, the complex of soil-transmitted helminthiases transmitted to humans is mainly produced by the nematodes of the genera Áscaris lumbricoides, Trichuris trichuria, Necator americanus and Ancylostoma duodenale [97]. As with species such as T. suis and T. trichuria, A. suum and A. lumbricoides are considered distinct species, which, traditionally, have been related to particular hosts [98,99]. Genetic evidence, however, suggests that there is a cross-infection between the parasites of the domestic swine and humans [100]. In contrast to countries such as Uganda, where there has been evidence of zoonotic transmission, no T. suis infections have been detected in Ecuador in humans [101]. Similarly, genotyping of adult parasites in countries such as the United States, Denmark, Brazil, Japan, the United Kingdom, China, Uganda and the United Kingdom have determined that ascaridiasis.

The human cases may be due, in part, to zoonotic transmission of A. suum [102-108]. However, in Ecuador, no nematodes were found after analyzing 381 nematodes from 22 children and 5 pigs, evidence of possible zoonotic transmission [104].

4. Conclusions

The present work highlights the lack of information and research on the main pathogens of the main pathogens in Ecuador associated with the absence of control and sanitary surveillance of diseases that endanger the health of pigs; not only the productivity of the swine industry but also public health is at risk. The practices of The management of the company's facilities have a major influence on the transmission of infectious and parasitic diseases among the animals for consumption and slaughter, including domestic swine. On the other hand, there is a risk of zoonoses of enormous impact on public health, many of them historically neglected. In addition to the issues discussed in this manuscript, it is clear that there are many challenges and opportunities to studying swine epidemiology in Ecuador.

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