

# Classical Swine Fever in Brazil: study for the survey of classical swine fever outbreaks in Brazil from 1978 to 2004

## Peste Suína Clássica no Brasil: estudo para a avaliação dos surtos de peste suína clássica no Brasil de 1978 a 2004

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### Abstract

The programs developed in Brazil with the aim to control and eradicate swine fever provided an opportunity for the survey of Classical Swine Fever (CSF) outbreaks. Were concerned CSF official programs, strategies and results, during 26 years. Based in epizootic official data we showed that the number of CSF outbreaks from 1978 to 2004 drastically decreased in all country, although different eradicating strategies were applied in those official programs, especially in fourteen States of “CSF Free Zone”. Were evaluated both CSF official programs: Swine Pests Combat Program (SPCP) from 1984 to 1991 and CSF Eradication and Control Program (CSFECP) from 1992 to 2004 by the decreasing of CSF outbreaks number. Considering the technical evolution in swine production systems, statistical analysis to compare the ranking of CSF outbreaks in each program was performed by Mann-Whitney test, that showed at 95% confidence level (Table T) a significant difference ( $p < 0.05$ ) between programs, as suggested in CSF outbreaks profile plotted diagram. The number of CSF outbreaks occurred from 2000–2004 in “CSF-infected” and “CSF-free” zones, was analyzed. Also, we regarded with most important recent CSF outbreak in Brazil occurred in 1997, during CSFECP, that was figured out by stamping out measures without appealing to preventive vaccination regimen. Those results suggest that the efficacy of implemented CSF eradication programs depends on the continuity of defined strategies as rigorous vigilance, notification, virus diagnostic screening and sanitary police measures in order to enable quick and adequate action upon CSFV detection. **Key words:** Classical swine fever, CSF outbreaks, epidemiology, Brazil

### Resumo

Os programas oficiais para o controle e erradicação de pestes suínas forneceram uma oportunidade de levantar o perfil de ocorrência da Peste Suína Clássica (PSC). Independente das estratégias aplicadas durante 26 anos foi demonstrado que o número de surtos de PSC de 1978 até 2004 caiu drasticamente em todo país, especialmente nos quatorze Estados inclusos na “Zona Livre de PSC”. O estudo comparou o

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número de surtos de PSC durante a vigência do Programa de Combate às Pestes Suínas (PCPS) de 1984 a 1991 e o Programa de Controle e Erradicação da PSC (PCEPSC) de 1992 a 2004. Considerando a evolução tecnológica nos sistemas de produção de suínos, a diferença nos resultados obtidos após a implementação de cada programa foi avaliada pelo teste estatístico Mann Whitney por meio da ordenação do número de surtos ocorridos. Essa análise demonstrou uma diferença significativa ( $p < 0,05$ ) entre os programas no nível de confiança de 95% (Tabela T) com havia sido sugerido pelo diagrama do perfil de ocorrência da PSC. A eficácia do PCEPSC para debelar o mais importante surto de PSC ocorrido recentemente no Brasil, em 1997, também foi considerada. Paralelamente, o número de surtos ocorridos de 2000 a 2004 nas áreas infectadas com a PSC e na zona livre de PSC foi avaliado. Os resultados sugerem que a eficácia dos programas de erradicação depende da continuidade das estratégias definidas como a vigilância rigorosa, notificação, rastreamento do vírus e medidas sanitárias que agilizem a ação no momento de detecção de vírus da PSC.

**Palavras-chave:** Peste suína clássica, Surtos de PSC, epidemiologia, Brasil

## Introduction

Classical Swine Fever (CSF) or Hog Cholera is a highly contagious viral disease of domestic and wild swine, caused by a Pestivirus from Flaviviridae family (VAN OIRSCHOT, 1989; DEPNER et al., 1995). The infection can occur in diverse clinical courses depending on the virulence of the virus strain. The acute form is caused by a virulent virus strain and generally results in high mortality whereas the infection with low virulence virus could be developed in an unapparent or atypical course (VAN OIRSCHOT, 1989). Classical Swine Fever Virus (CSFV) has a positive single stranded RNA and a 12kb length infectious genome (RUMENAPT et al., 1991). This disease is considered the major cause of economic losses to the swine industries and the pig farmers because beyond the mortality and reduction of productivity, the CSF leads to restrictions to the potential market and condemns the swine products (DESCHAMPS; LUCIA JÚNIOR; TALAMINI, 1998). CSF has a worldwide distribution being considered endemic in South America, China, India, and probably, Russia (VAN OIRSCHOT; TERPSTRA, 1989). The reports from the BULLETIN OF OFFICE INTERNATIONAL DES EPIZOOTIES (1998) of CSF outbreaks, which occurred in many countries in Europe, Asia, and Central America, emphasized the economic importance of this disease.

In the last decades, Brazilian production of swine for internal consumption and exportation had a

considerable approach in technology investments, especially in South and Southwest areas where the major swine farms are found. The modern swine producers have to attend the demand of biosafety commodities with monitoring hazards of production regarding the diseases control. Swine disease control has been fundamental to guarantee the quality of swine products. In the past, Brazil developed with success a program to eradicate African Swine Fever (ASF) caused by African swine fever virus – ASFV, (BRASIL, 1982; BRASIL, 1984). In 1980, the Ministry of Agriculture established an official Swine Pests Combat Program (SPCP) with the aim to eradicate ASF and to control CSF (BRASIL, 1984). In 1984, after eradication of ASFV, control of CSF has turned the main purpose of that program based on vaccination. Although this program was applied to control the disease it could not eliminate the virus. Many CSF outbreaks still occurred in all country.

That previous experience contributed to implant specific CSF Control and Eradication Programs, which were developed in agreement with the international demand. In 1992, the official program conceived to eradicate the virus was reformulated. The CSF Control and Eradication Program (CSFCEP) aimed to progressive CSF combat gave priority to regions in function of economic importance in swine production and epidemiological conditions (BRAZIL, 1994). It began with country's division in separated areas; Area 1: No CSF vaccination applied; Area 2: CSF vaccination was obligated; Area 3: CSF

vaccination was voluntary. Initially, vaccination against CSF was prohibited in South Region (Paraná, Santa Catarina and Rio Grande do Sul) where the swine production area presented a high level technology, and also sanitary and safety conditions. The objective of that program was to quit vaccination against CSF in all territory, gradually. To attend the exigency of this program, the improvement of viral diagnostic laboratorial techniques and differential diseases tests were implanted. Some serological measures for CSFV antibody screening were standardized and implanted for laboratorial routine (FREITAS, 1995; FREITAS; CALDAS; REBELLO, 1999). In 1995, other three federal States – Minas Gerais (MG), Mato Grosso (MT), Mato Grosso do Sul (MS) – were included in the area 1 of CSFCEP (BRASIL, 1995). In 1997, the rules for Certification of Minimal Diseases Swine Farms were implemented (BRASIL, 1997).

In 1998, the CSFCEP applied more rigorous measures that prohibited vaccination against CSF in all country. The vaccination could be allowed only under official authorization and control. Official implementation of rules to validate the quality of swine farms included a certification of swine farms with minimal disease and wild boar certificated farms, which were submitted to an intense and rigorous serological monitoring.

In 2000, with statistical methods to screening CSFV activity in States, sera-epidemiological investigation was made in order to confirm the CSFV free status to be included in a free zone that would be delimited. In 2001, after sera-epidemiological analytical results, CSF “Free Zone” including fourteen States was officially implemented. The CSF Contingency Plan gave more efficacy to CSFCEP with new rules that allowed an official preventive vaccination in the States of Northeast region, which were out of the CSF free zone, and was named “infected area”. Those States were submitted to a strategic plan of vaccination, “the official needle” with Chinese strain vaccine applied upon official control (BRASIL, 2001). In 2003, CSF sera-

epidemiological investigation was made again in fourteen States of CSF free zone in order to confirm virus-free status. It involved all kind of swine production farms, domestic and industrial systems, including wild swine farms.

In this paper we analyzed the occurrence of CSF from 1978 to 2004 in all Brazilian territory. We studied the results of main CSF combat programs developed in the country including the most important recent CSF outbreak in Brazil occurred in 1997, during CSFCEP, which was figured out by stamping out measures without appealing to preventive vaccination. Considering the technical evolution in swine production systems, the period submitted to official CSF programs (1984-2004) was studied by a non-parametric statistic method, the Mann Whitney test. We also evaluated the first results (2000-2004) of CSF vaccination regimen strategies in Northeast region (infected area) compared with CSF non-vaccination areas in the same period.

## Material and Methods

### *CSF epidemiological occurrence data:*

Data of epidemiological occurrence of CSF were obtained from trimester reports from Agriculture Defense Secretary of Agricultural Ministry of Brazil from 1978 to 1991. During 1978-1979 an emergency plan was running to combat African swine fever that stamped out 266,000 pigs from focus areas, especially in Southeast region. From 1980 to 1984, an ASF attack plan destroyed all infected animal and a mass vaccination against CSF was applied (BRASIL, 1982; BRASIL, 1984).

The serological survey from 1992 to 1998 was obtained from official epidemiological vigilance report. From 1998 to 2000, the attention was to surveillance of the expected “Free Zone”. To determine the absence of reactive animals to CSFV antibodies, the study was based in the following strategies: 1) Serum samples from each swine of all small farms were collected, and 2) From farms with no CSF episode,

representative serum samples collected was 30% of the total number of swine from each farm.

In active vigilance, the objective of sera epidemiological investigation, either in 2000 and 2003, was to detect the absence of virus activity at sampling process at a confidence level of 95%. It should be capable to detect the presence of infected swine in all investigated swine farms. But, the big area of CSF Free Zone embraced different epidemiological conditions and swine production systems with intense inter-relationships.

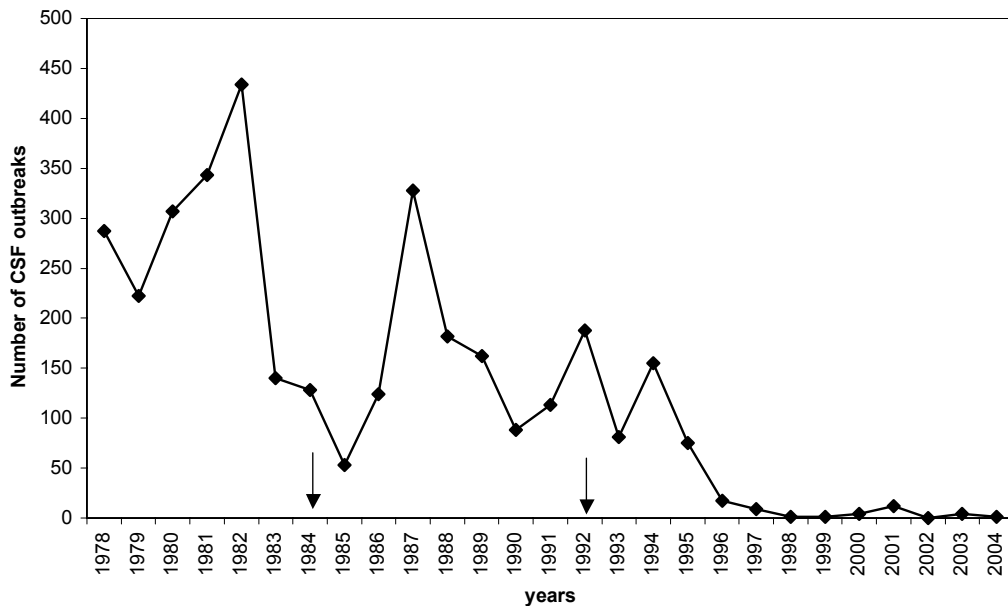
Based on sanitary conditions, proximity, contiguity, and relationships intensity as animal traffic and/or for market, the CSF free zone was divided in four subpopulations (strata), in order to obtain homogeneity in the group of analyzed swine herds. Epidemiological and Parametric Statistic for each subpopulation were determined. In 2000, a total of 28,717 serum samples from 2066 farms of CSF Free Zone States without virus activity detection or without CSF episodes in the later two years were collected and tested by a commercial ELISA. Suspected or positive samples

were confirmed by virus neutralization test (NT). In 2003, the sampling of swine for CSF antibodies screening of CSF Free Zone reached 27,149 serum samples from 3,023 farms, including serum samples of emergent and wild pigs farms.

In both campaign, in CSF antibodies screening, all swine farms that presented reactive swine for antibodies against CSFV were submitted to complementary epidemiological investigation. That included a detailed investigation of CSF vaccination reminiscences sows, sera investigation, and sampling for virus isolation, particularly at the last states included in CSF Free Zone.

#### Data analysis

CSF outbreaks occurred in Brazil from 1978 until 2004 were plotted by year (MALETTA, 1992) in a representative diagram (Figure 1). Nevertheless from 1978 to 1983, the main official program aimed to eradicate ASF. So, for statistical analysis was considered the year of 1984, when a specific program to combat CSF started.



**Figure 1.** Classical Swine Fever (CSF) outbreaks in Brazil from 1978 to 2004. The profile shows the decrease of CSF outbreaks by years. Black arrows indicate CSF official programs implemented. 1984: Program to Combat Swine Pests (PCSP); 1992: Classical Swine Fever Control and Eradication Program (CSFCEP).

Considering fundamental modifications in Brazilian swine rearing during 21 years (1984 to 2004) it was necessary to apply an independent non-parametric (distribution free) comparison for two groups, the Mann-Whitney Test. In this case, the non-parametrical test is recommended because the impost treatment is response eliminator (outbreaks/focus); the variances of two periods are not equivalent, the data don't reflect a Normal distribution and we can not move them to Normal distribution, they are not paired and  $n_1 \neq n_2$  (LEHMANN, 1975; SAMPAIO, 1998; WILCOXON, 1945). We use Mann-Whitney table to find critic T and determined if there was significant difference. For ordination we divided in two periods exposed year-by-year. Period 1 ( $n_1$ ): 1984 to 1991 and Period 2 ( $n_2$ ): 1992 to 2004. We found  $T=126$  ( $n_1$ ) and  $T=105$  ( $n_2$ ). We applied the formula  $T' = n_1 (n_1 + n_2 + 1) - T$  to calculated  $T'$ . Concomitant with Mann Whitney test, the data was analyzed in Minitab software to confirm the reliable of results.

From 2000 to 2004, we observed two areas with different strategies for CSF combat in CSF Contingency Plan: At the Northeast region of the country, excluding Bahia and Sergipe States, within the called infected area, the control of CSF was still based on vaccination against CSFV with attenuated Chinese strain and at South, Southeast and Northwest regions, the Free Zone, no CSF vaccination regimen was adopted. Considering five years as a short period for statistical analysis, we plotted in curve diagram the number of CSF outbreaks in each area (Figure 3) to evaluate the different strategies in course.

#### *Analysis of CSF outbreak occurred in Paraná, in 1997*

Statistical methods to screening CSFV activity based in sera-epidemiological investigation in order to confirm the CSFV free status in Paraná was made. The sera analysis involved 8580 swine serum samples were collected from swine farms of 157 municipal districts in swine production areas. The sera samples were taken during the period between 1997 and 1998.

The total of sera collected represented all swine of each farm close to the outbreak region. And, the virus isolation included 441 samples of swine organs, preferentially tonsils, lymph nodes, kidney and spleen collected from suspect swine at regional abattoirs were submitted to cryostat cuts and direct immune fluorescence for preliminary analysis and subsequently for virus isolations in Pk15 cells line, standardized for use in all official laboratories of Agricultural Ministry.

## **Results and Discussion**

CSF has a worldwide distribution being epizootic in Europe and enzootic in South and Central America. Since 80's, several programs to control and eradicate CSF were applied in different countries but without plain outcome (EDWARDS, 1990). Several investigations tried to explain the reasons for CSF recrudescence, as the use of contaminated food, the direct contact of susceptible animals with infected swine during the transport or by the use of contaminated tools (VAN OIRSCHOT, 1989; EDWARDS, 1990). After a back tracing of clinical event and spread of disease, Terpstra e Smit (2000) concluded that a contaminated lorry could be responsible for the introduction of CSFV in the swine herd in the Netherlands. To avoid this kind of risks many countries closed the swine market and commercial relationships with countries where CSF was not eradicated or were still using vaccination to control CSF (OFFICE INTERNATIONAL DES EPIZOOTIES, 1992).

In Brazil, the historical of CSF control and eradication programs evolved from a general program against swine fever (PCPS) in 1982, which aimed to eradicate ASFV to a specific CSFV eradication program, in 1992. Considering that the number of CSF outbreaks could indicate if the strategies applied to control the disease were efficient, in many countries the strategies to combat were not (EDWARDS, 1990), including the PCPS that aimed to control the disease but not the virus elimination.



The number of CSF outbreaks occurred from 1978 to 2004 could be used to study the evolution of CSF control in Brazil. We plot the number of outbreaks by year occurred from 1978 until 2004 (Figure 1). Although the CSF outbreaks number was high, in 1978, we saw a slight decline of outbreaks followed by a rising of CSF outbreaks from 1979 to 1982. The official reports cited that vaccinations against CSFV were applied since 1979 (BRASIL, 1984). The vaccination could not inhibit the occurrence of CSF outbreaks, immediately. We saw that the number of CSF outbreaks in 1980 reached over 300 and in 1981 it was still raising, reaching more than 400 outbreaks in 1982. But, we realized that from 1983 to 1985, the number of CSF outbreaks had drastically decreased, reaching 50 occurrences in all territory. It probably was not only in consequence of CSF vaccination because, in parallel, to attend the PCPS, many efforts were made to avoid the recrudescence of ASF focus, as the control of animal traffic from areas with high concentration of swine population areas, and the intensification of epidemiologic vigilance. In 1984, Brazil was declared ASF-free (BRASIL, 1984). In 1986, we could observe that the number of CSF outbreaks started rising again, reaching over 300. It could suggest that some problem in the implantation of vaccination program in middle of 80's hindered the reduction CSF outbreaks number. But, in the end of 80's, CSF outbreaks number decreased again. In 90's, at North States and mainly at Northeast States, CSF outbreaks were gradually reducing from 170 in 1992 to 84 in 1995, when affected 315 animals. No outbreaks occurred in the years of 1997 and 1998. Following it, we observed an oscillatory recrudescence of 22 CSF outbreaks in 1999 to 2004. In South region CSF outbreaks number reached up 31 in 1993, decreasing to zero in 1999, which is maintained until now.

Until 1992, Brazilian strategy to reduce outbreaks based in vaccination of swine flocks with Chinese strain attenuated vaccine had effective results (LYRA, 2006; LYRA; REIS; SILVA, 1982; BRASIL, 1982; BRASIL, 1984). The vaccination

regimen associated with stamping out measures to kill all the animals affected by the virus was believed to be the better way to control the outbreaks in enzootic areas (BIRONT; LEUNEN; VANDEPUTTE, 1987; TERPSTRA; WENSVOORT, 1987; TERPSTRA, 1993). The virus, however, could be maintained in swine herds as cited by Bersano, Villalobos e Batlouni (2001). Vigilance and defensive measures were implemented. But, an apparent fragility of the earlier program, maybe the discontinuity of severe rules to combat the disease associated with lacking of information of the real importance of CSF disease to swine producers, were the cause of some occurrences. For example, in 1985, 53 CSF outbreaks were cited (BRASIL, 1987). But, in that year the obligation by swine producers to present CSF vaccination documents ceased. In 1986, CSF outbreaks recrudesced to 124 and reached 328 in 1987 (Figure 1). In that time the strategies to CSF combat moved to quit vaccination in many swine producers countries because of the impossibility to differentiate antibodies from vaccinated and non vaccinated animals hindered epidemiological survey.

The CSFCEP begun in Santa Catarina (SC) and Rio Grande do Sul (RS) followed by Paraná (PR). SC and RS have been maintained as CSF-Free. But in 1997, Paraná suffered a CSF outbreak, which was the most important recent CSF outbreak that affected the swine flock in Brazil during the CSFCEP. It was figured out by stamping out measures without appealing to preventive vaccination regimen. Altogether 970 pigs, dispersed over 7 farms, became ill and 270 animals died. Sanitary and stamping out measures that resulted in the slaughter of 1807 animals controlled the outbreak. In parallel, investigations to identify the sources of infection were implemented in the region. The results of CSFV isolation from 441 tissues samples demonstrated that 98.64% of them were negative for CSFV. The screening of antibodies showed that 99.82% of 2747 animals tested from March to December of 1997 were not reactive to CSFV. In 1998, from January to

July, the serological survey showed that from 5833 animals tested, 99.99% were not reactive for antibodies against CSFV and 100% of the tissues samples collected were negative for immune fluorescent antigens. No CSF outbreaks occurred since 1998 to 2004 in Paraná State.

Gradually, other States were included in CSFCEP without vaccination. The last State to control CSF without vaccination was the State of São Paulo, which suffered six CSF outbreaks from 1996 to 1998. All swine affected by the disease were destroyed. After 1998 no CSF outbreak was reported.

The advances in CSF eradication program can be evident when new regions are declared free from the disease. In 2000, sera investigations against CSFV, screened 2066 swine farms and tested 28,717 serum samples that figured out in 277 (0.96%) reactive samples detected by NT in 83 (4%) swine farms tested. The CSF complementary epidemiologic analysis did not detect viral activity neither in a second sampling nor in cell culture virus isolates. In 2001,

consequently, after these results, the CSF Free Zone was delimited (Figure 2) including fourteen States from 3 geographic regions: South, Southeast, West and Northwest Paraná (PR), Santa Catarina (SC), Rio Grande do Sul (RS), Espírito Santo (ES), Rio de Janeiro (RJ), São Paulo (SP), Minas Gerais (MG), Distrito Federal (DF), Goiás (GO), Mato Grosso (MT), Mato Grosso do Sul (MS), Tocantins (TO), Bahia (BA) and Sergipe (SE). In 2003, CSF Free Status of those States was confirmed by the absence of swine reagent for CSF antibodies in sera epidemiological investigation that was based in similar statistical criteria of 2000. The 2003 CSF antibodies screening, performed by testing 27,149 sera from 3023 farms, demonstrated a decrease of 87% of CSF reactive sera when compared with results of 2000. The number of farms with reactive animals also decreased to 0.2% of total of swine farms screened. After specially drove investigation, it was demonstrated that CSF reactive samples were collected from reminiscent vaccinated old sow. It was not detected CSFV in PK15 cell isolation.



**Figure 2.** Brazil, geographic division. The 14 Brazilian States included in the CSF Free. Zone 2001 are showed in dark and textured area.

The program implemented from 1992 to 1998 (CSFCEP) drove to virus eradication and non-vaccination regimen was introduced into the biggest pig production regions with high-density swine population, while for others regions of the country the vaccination could be applied. The concerning about a large number of divergent factors influencing the CSF epizootic studies (TERPSTRA, 1993), including the animals movement among those areas, especially between farms from the same owner, impelled to improve veterinary vigilance measure, in despite of the fact that, the principal direction of swine movement in Brazil was from non-vaccinated to vaccinated regions. The importance of intensified vigilance to avoid a CSFV reintroduction in one region was demonstrated by CSF outbreak occurred in Paraná, in 1997. In parallel, the dynamic to rapid implementation of emergence measures to eliminate the CSF outbreak without appealing to vaccination should be considered as efficacy of CSFCEP. In comparison, the number of swineherds affected by CSF in Brazil was always smaller than those cited in Europe last years (EDWARDS, 1990). Maybe it occurs due to differences in density swine population, which is higher in European countries (TERPSTRA; SMIT, 2000).

The vast modifications occurred in swine production system along those 26 years must be considered to analyze data from 1984 until now. The number of animals reared in country still similar, around 30 million. But, the investments in technology moved with quality and swine productions increased with kinds of specialized farms as the final swine production destination. Deschamps, Lucia Júnior e Talamini (1998) cited that the major increase projected in Brazilian swine production was for exportations. By the diagram analysis (Figure 1) during the first program (PCPS: 1984-1991) we could see an oscillatory curve of CSF outbreaks number, which suggest many problems in strategies implemented. But it is important to take into account the difficulties to implant a PCPS in all territory concerning the size of the country and swine producer's information. By

the diagram profile we could point differences between the programs results but it was necessary a mathematic statistical analysis to corroborate them. In despite of Swine Pests Combat Program (SPCP), period 1: 1984–1991, many CSF outbreaks occurred. After CSFCEP implementation, period 2: 1992-2004, the number of CSF outbreaks drastically reduced. Mann-Whitney analysis demonstrated a significant difference ( $p < 0.05$ ) at 95% confidence level (Table T). In agreement with Mann Whitney, the Minitab analysis of Medians could not reject the null hypothesis ( $H_0$ ) since figured out in  $p < 0,05$  ( $p=0,0065$ ) at 95 % confidence level. Also, we can note a concordance between the statistical analysis with the diagram (Figure1), which showed the difference in the profile of CSF outbreaks in periods 1 and 2.

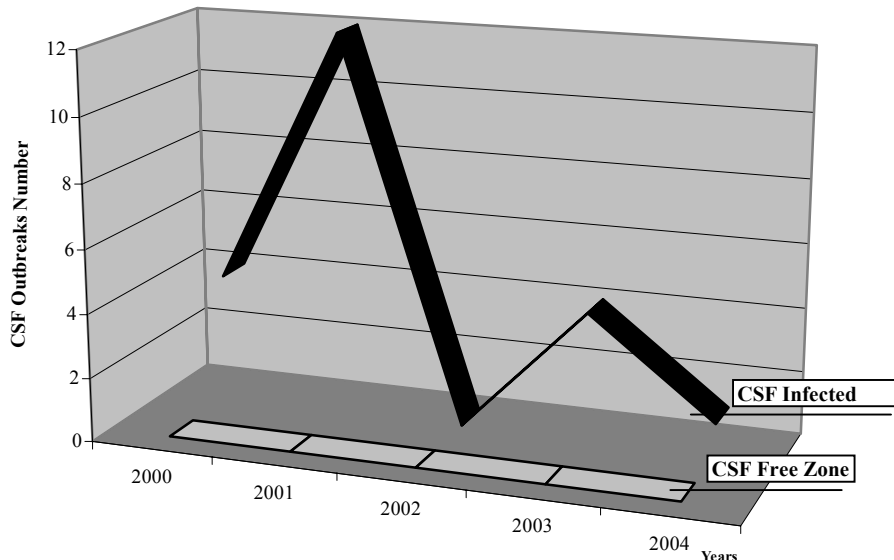
In spite of the CSFCEP (1992) aim to quit vaccination in all country gradually, in 2001, the States of Northeast region: Alagoas (AL), Ceará (CE), Maranhão (MA), Paraíba (PB), Pernambuco (PE), Piauí (PI), Rio Grande do Norte (RN), were authorized to use live attenuated vaccine to control CSF outbreaks. The comparison of profiles from CSF outbreaks data (2000-2004) plotted in the curve diagram showed that, while no CSF outbreaks occurred in CSF Free Zone, it still occurred in CSF Infected zone. CSF outbreaks profile in Northeast region presented an oscillatory or sinuous curve with twelve CSF outbreaks in 2001, zero in 2002 and four in 2003. In 2004, until November one CSF outbreak was detected in CE (Figure 3).

Brazil has a continental area of 8.511.965 km<sup>2</sup> with different geographic regions. The swine production in CSF Free Zone is around 75% of total Brazilian swine production. It has 3.617.245 Km<sup>2</sup> of national territory and is demarked by geographic barriers that contribute to avoid the virus dissemination, as the Amazonian rainforest in the North and the mountains of Maciço do Borborema at the Northeast. Those natural barriers contributed to limit a CSF "Free Zone" including 14 Brazilian States without CSF outbreaks in following two years



associated with no reactive animal serum samples for antibodies against CSFV, as considered by the international rules of epidemiology control (OFFICE INTERNATIONAL DES EPIZOOTIES, 1998). At those Brazilian States no CSF outbreaks occurred since 1998. Among them, the States of Rio Grande

do Sul; Santa Catarina; Minas Gerais; Mato Grosso and Mato Grosso do Sul are free of CSFV for more 10 years. In addition, at the borders of Free Zone States, a vigorous veterinary policy was implanted. CSF Free Zone was confirmed by official sera epidemiology survey in 2003 (Figure 2).



**Figure 3.** Comparison of Classical Swine Fever outbreaks in Free Zone and Infected Zone from 2000-2004. The profiles show that, while no CSF outbreaks have been occurred in CSF Free Zone, it still occurred in CSF Infected zone.

## Conclusion

Certainly, all strategies contributed to decrease the number of CSF outbreaks. But, to eradicate the disease in all Brazilian territory, those measures associated with a rigorous control of animal movement in all country backed up with serological investigations, specially in high density pig population, need to continue until no more outbreaks could be cited in all country, as suggested by the diagram profile of CSF occurrence from 1978 to 2004.

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