VIABILIDADE DA UTILIZAÇÃO DE ESTERILIZADOR DE AR NA SALA DE MATERNIDADE EM GRANJAS DE SUÍNOS

Francisco Rafael Martins Soto[*1]
Daniel Matias[2]
Nilson Roberto Benites[3]
Priscilla Anne Melville[4]
Silvio Arruda Vasconcellos[5]
Cideli de Paula Coelho[6]
Sérgio Santos de Azevedo[7]

RESUMO

Este experimento avaliou a utilização de esterilizador de ar sobre o desempenho zootécnico e seu custo benefício na maternidade de uma granja de suínos. Dois grupos foram formados: com esterilizador de ar-grupo tratado, e controle com 16 fêmeas suínas cada um. Foi avaliado: mortalidade de leitões, peso dos leitões ao desmame, ocorrência de diarréias, consumo de ração das fêmeas, comportamento das fêmeas e das leitegadas e odor das salas. Com a utilização de placas de cultivo bacteriano foi mensurado o crescimento de bactérias Gram negativas, Gram positivas e fungos em suspensão. No grupo controle a taxa de mortalidade foi de 12,71%, e no grupo tratado foi de 6,96%. A ocorrência de diarréia nos leitões no grupo controle foi de 22 animais, no grupo tratado foram seis com significância estatística. O total de ração consumida pelo grupo tratado foi de 2038,2 Kg com média diária de 4,54Kg por fêmea e grupo controle foi de 1912,5Kg com média diária de 4,26Kg. No grupo controle o peso médio ao desmame foi de 5,97 Kg *versus* 6,70 Kg no grupo tratado com significância estatística. O escore médio diário do comportamento das fêmeas do grupo controle foi de 1,32 pontos *versus* 1,01 no grupo tratado com significância estatística, e dos leitões foi de 1,12 no grupo controle *versus* 1,04 no grupo tratado. Para o parâmetro odor das salas, no grupo controle o valor total foi de 154 pontos *versus* 102, no grupo tratado com significância estatística. Não foram observadas diferenças estatisticamente significantes quanto aos resultados de crescimento bacteriano nas placas de cultivo nas amostras tratadas em relação às controle. A utilização do método físico de esterilização de ar na maternidade contribuiu para melhorar o desempenho zootécnico dos animais.

Palavras chave: suínos, maternidade, esterilizador de ar.

[1*] Médico Veterinário, Doutor, Caixa Postal 34 - Ibiúna -SP- Brasil, CEP- 18150-000, endereço eletrônico:chicosoto34@gmail.com Fone fax 00 55 15 3294-2223

[2] Adminstrador de Empresas, Air Free Agro do Brasil, Rua Lourenço de Almeida, 247, Bairro Vila Nova Conceição, CEP 04505-970, São Paulo, SP, Brasil,endereço eletrônico: daniel.matias@airfree.com

[3] Médico Veterinário, Doutor, Professor Associado, Universidade de São Paulo, Faculdade de Medicina Veterinária e Zootecnia, Avenida Dr. Orlando Marques Paiva, 87, Butantã, CEP 05508-270, São Paulo, SP, Brasil, endereço eletrônico: benites@usp.br

[4] Médica Veterinária, Doutora, Universidade de São Paulo, Faculdade de Medicina Veterinária e Zootecnia, Avenida Dr. Orlando Marques Paiva, 87, Butantã, CEP 05508-270, São Paulo, SP, Brasil, endereço eletrônico: melville@usp.br

[5] Médico Veterinário, Doutor, Professor Titular, Universidade de São Paulo, Faculdade de Medicina Veterinária e Zootecnia, Avenida Dr. Orlando Marques Paiva, 87, Butantã, CEP 05508-270, São Paulo, SP, Brasil, endereço eletrônico: savasco@usp.br

[6] Médica Veterinária, Mestre, Universidade de São Paulo, Faculdade de Medicina Veterinária e Zootecnia, Avenida Dr. Orlando Marques Paiva, 87, Butantã, CEP 05508-270, São Paulo, SP, Brasil, endereço eletrônico: ccideli@uol.com.br

[7] Médico Veterinário, Doutor, Professor Associado, Unidade Acadêmica de Medicina Veterinária da Universidade Federal de Campina Grande, Campus de Patos, Avenida Universitária, s/n, Bairro Santa Cecília, CEP 58700-970, Caixa Postal 64,Patos, Paraíba, Brasil, endereço eletrônico: sergio@vps.fmvz.usp.br

VIABILITY OF UTILIZATION OF THE AIR STERILIZATION IN THE ROOM MATERNITY IN SWINE FARMS

ABSTRACT

This experiment evaluated the utilization of the air sterilizer about the zootecnic performance and its cost benefit relation for the maternity stage of a swine farm. Two groups of 16 sows each were used: a treated one with air sterilizer and a control group without treatment. It was observed: the occurrence of mortality in piglets, weight of piglets at weaning, diarrhea, food consumption, sows and piglets' behavior and odor of the maternity room. Growing of Gram negative and positive bacteria and fungi were measured using seed agar plates exposed to maternity environment. Control group mortality rate was 12.71% and for treated group it was 6.96%. Diarrhea occurred in 22 piglets from control group against six for piglets of treated group with statistical significance. Control group mean weight at weaning was 5.97 Kg against 6.70 Kg for treated group with statistical significance. Total food consumed by treated group sows was 2,038.2 Kg with daily mean of 4.54 Kg per sow and control group was 1,912.5 Kg with daily mean of 4.26 Kg. Control group points for the parameter odor of the room were 154 against 102 for treated group with statistical significance. The mean daily score of behavior of sows control group was 1.32 *versus* 1.01 in the treated group with statistical significance, and the piglets was 1.12 in the control group *versus* 1.04 in the treated group. For the parameter odor of rooms, in the control group the total value was 154 points versus 102, in the treated group with statistical significance. No significant difference was observed in relation to bacteria growth in plates when compared treated and control groups. The use of the physical method for air sterilization at the maternity contributed to increase zootecnic performance of the animals.

Key words: swine, maternity, air sterilizer.

VIABILIDAD DE LA UTILIZACIÓN DE ESTERILIZADOR DE AIRE EN LA SALA DE MATERNIDAD DE GRANJAS DE CERDOS

RESUMEN

Este experimento evaluó la utilización de esterilizador de aire sobre o desempeño zootécnico y su costo beneficio en la maternidad de una granja porcina. Dos grupos fueron formados: con el esterilizador de aire - grupo tratado, y el control con 16 hembras porcinas cada uno. Se evaluó: mortalidad de lechones, peso dos lechones en lo destete, ocurrencia de diarreas, consumo de pienso de las hembras, comportamiento de las hembras y lechones y el olor de las salas. Con el uso de placas de cultivo bacteriano se mensuró el crecimiento de bacterias Gram negativas, Gram positivas y hongos en suspensión. En el grupo control, la tasa de mortalidad fue el 12,71%, y en el grupo tratado fue el 6,96%. La ocurrencia de diarrea en los lechones en el grupo control fue de 22 animales, en el grupo tratado fueron seis y estadísticamente significante En total de ración consumida pelo grupo tratado fue de 2038,2 Kg con media diaria de 4,54Kg por hembra en lo grupo controle fue de 1912,5Kg con media diaria de 4,26Kg. En el grupo control el peso medio al destete fue de 5,97 Kg *versus* 6,70 Kg en el grupo tratado y estadísticamente significante. Para el parámetro olor de las salas, en el grupo control el valor total fue de 154 puntos *versus* 102, en el grupo tratado y estadísticamente significante. En lo comportamiento das hembras del grupo controle con escore medio diario fue de 1,32 pontos *versus* 1,01 en lo grupo tratado y estadísticamente significante. No se observó diferencia estadísticamente significante cuanto a los resultados de

crecimiento bacteriano en las placas de cultivo en las muestras tratadas en relación al control. El empleo de método físico de esterilización de aire en la maternidad contribuyó para mejorar el rendimiento zootécnico de los animales.

Palabras claves: cerdos, maternidad, esterilizador de aire.

INTRODUCTION

The main objective of swine industry is to maximize meat production in tons per sow per year. Among the problems faced on swine exploitation, infectious diseases are considered important and cause considerable losses in a swine commercial farm (1). Maternity is the stage where losses can be bigger with the occurrence of enteric or respiratory infectious diseases that affect piglets. Most important bacterial microorganisms responsible for mortality of weaned piglets or their rejection with reduction of weight gain and that may be present as suspension at swine facilities are: Streptococcus suis, Haemophylus parasuis, Pasteurella multocida, Mycoplasma hyopneumoniae and *Escherichia coli* (2).

The most important viral microorganisms that may contribute to increase piglets' mortality at the maternity are: rotavirus, swine circovirus and reproductive and respiratory swine syndrome (2).

Searching solutions to increase productivity levels, environmental interventions of swine facilities are indicated. Studies have been made using chemical methods constituted by disinfectants applied through aspersion, nebulization or pulverization at swine facilities to control, reduce or eliminate pathogenic microorganisms present in the air (3, 4).

Researches evaluating air sterilizers to control, reduce or eliminate the presence of pathogens are common for human environment, mainly for food industry (5) hospital surgical centers, odontologic clinics and pharmaceutics industry (6, 7, 8). However there is a lack of research of this theme for animal intensive raising, mainly swine meat. There is also need to study physical methods of air sterilization for this problem.

The objective of this experiment was to evaluate in relation to mortality rate and gain of weight for piglets at weaning phase, using a physical disinfection and sterilization method of the maternity room air, as well as its cost benefit relation.

MATERIAL AND METHODS

The experiment was developed at a commercial swine farm from Ibiúna Municipality, São Paulo, Brazil, with 200 sows. Females were cross bred from Landrace and Large White with similar genetic and history of parturition (between first and fifth parturition). Animals were kept at the maternity with three meters foot high and farrowing crates with slotted floor. Food for sows was composed of ground corn, soybean meal, macaroni, defatted corn germen and vitamins and mineral supplementation calculated. Nutritional levels were 18.43% crude protein, 4.27% ethereal extract, 3.34% crude fiber, metabolic energy of 3,300 Kcal and 1.00% lysine. Mean quantity of food was 3.00 Kg per sow until five days after parturition. After this period, food was given "*ad libitum*" in individual feeders. Water was supplied in suckling type drinker placed beside feeder.

Two groups of a total 32 sows were separated into four maternity rooms, with eight sows each. Two rooms with 16 sows and without air sterilizer equipment belonged to control group and sows from the treated group were kept at the other two rooms, containing one air sterilizer equipment for each farrowing crate during 24 hours at one meter high from the floor. The equipment used was made of ceramics with an internal electric resistance of 220 volts and it was protected with plastic, which allowed air flow in it. Air sterilizer dimensions were

13 cm diameter and 34 cm high. Experiment was developed during 28 days, comprehending from sows' placement at farrowing crate one week before birth and 21 days until weaning.

Using control files during experimental period, the following parameters were evaluated:

a) Mortality of piglets, its cause and age of animals at death;

b) Mean birth and weaning weight of the piglets;

c) Microbial growing;

d) Occurrence of diarrhea using the method described by Mores (9);

e) Daily food consumption for sows;

f) Behavior of piglets and sows. Adopted score was from one to three as follow: one – calm level, two – medium level and three – agitated level;

g) Odor of the rooms. Adopted score was from one to three as follow: one – without odor, two – medium level and three – high odor level;

To define the scores of daily total values for piglets and sows and odor of the rooms, evaluation took three months during morning, afternoon and evening by visual observation of animals and sensorial smelling.

Considering the parameters minimum, mean and maximum temperature of external environment and of maternity room and air humidity, two daily air evaluations were made during morning and afternoon (table 1). Maternity temperature control for both experimental and control groups was made using curtains, totalizing 21 procedures of opening and 21 closures during evaluation period (table 1).

Microenvironment temperature for piglets was controlled using electric warmers, which were turned on for 16.2 hours and they were turned off for 7.8 hours to ensure temperature comfort for animals.

Plates with addition of chloranfenicol were exposed in duplicate at maternity environment for ten minutes and then they were close and shipped under refrigeration to microbiology laboratory. Plates were exposed in nine different days, considering days 09/20, 09/28, 10/08 and 10/11/2007 for treated group and 10/16, 10/19, 10/23 and 31/10/2007 for control group.

Plates containing blood sheep agar media culture (5%), MacConkey agar, agar for standard counting were incubated at 37°C for 24-48 hours. Plates containing Sabouraud dextrose agar were incubated at 25°C for seven days. After incubation periods plates were submitted to forming unit counting (F.U.C.) and for MacConkey agar plates it was also made differential counting for lactose positive and negative bacteria, filamentous fungi and yeast.

It was measured electric power consumption of treated group and its cost benefit relation using an electric meter in KW/hour. All zootecnic indexes for maternity were obtained through data stored at specific software of the farm, named Suinsoft version 3.0.7 (10).

To compare quantitative variable between groups (mean weight at birth, mean weight at weaning phase and mean daily score – sows behavior, mean daily score – piglets behavior and mean daily score - odor of the rooms), the Kolmogorov-Smirnov normality test was first adopted. The *t*-test was adopted for variable with normal distribution; for those variables with non-normal distribution the Mann-Whitney U test was used (11). To compare proportions of diarrhea occurrence and mortality rate, the chi-square test was used. For all zootecnic performance analysis the significance level adopted was 5% and the statistical program adopted was the *SPSS for Windows* version 13.0. Media culture statistical analyses were made using the Mann-Whitney and T tests, with the software GraphPad Instat 3- Copyright Instat (12).

Table 1.Means external environment temperature and maternity room temperature and humidity defined as current, maximum and minimum, according to the evaluation period.

Parameter	Period					
	Morning			Afternoon		
	Current mean	Maximum mean	Minimum mean	Current mean	Maximum mean	Minimum mean
Mean external environment temperature (T°C)	16.81	23.14	12.39	21.60	28.42	15.03
Mean environment temperature of maternity (T°C)	19.53	24.14	17.42	23.00	28.20	17.96
Mean air humidity of maternity (%)	67.10	68.00	54.96	54.80	66.10	44.10

RESULTS AND DISCUSSION

For bacterial growing plates results, considering all five samples for treated group and control, median counting of F.C.U with 10 minutes of environmental exposure, were respectively: Gram positive bacteria was 287 (277 to 295) and 283 (254 to 297), Gram negative bacteria was 13 (5 to 23) and 17 (3 to 46), lactose positive bacteria was three (1 to 5) and 6 (1 to 14), lactose negative bacteria was 10 (4 to 18) and 11 (2 to 32), total fungi was 41 (10 to 69) and 38 (27 to 59), filamentous fungi was 17 (3 to 42) and 15 (2 to 34) and for yeast was 13 (5 to 35) and 23 (17 to 31).

Although no significant statistical differences were observed for microbial media growing results when compared treated and control groups, the results obtained when using air sterilizer at maternity room were favorable.

Mortality rate for control group was 12.71% and for treated group it was 6.96% with a reduction of 45.23% (table 2). Despite this result, there was no statistical difference for this parameter (P= 0.159)

Table 2. Results of deaths and occurrence of diarrhea in piglets for treated and control groups.

Parameter	Control group	Treated group	P value
Total number of newborns	118	158	-
Number of death	15	11	-
Mortality rate (%)	12.71%	6.96%	0.159
Number of piglets with diarrhea	22	06	-
Diarrhea occurrence rate(%)	18.64%	3.79%	0.0001

Major causes of death for control group were crushing of piglets, unspecific diarrhea and malnutrition due to low weight at birth and occurring mainly from the first to the fifth days. Causes of death for treated group were the same of control group except for unspecific diarrheas. The number of piglets suffering from diarrhea at control group was 22 animals or 18.64% from the total and for treated group six animals or 3.79% were affected (P= 0.0001). These results are similar to those of Vieira (13), in a swine herd of Portugal where he

observed a reduction of 56% for piglets' mortality rate at the maternity using air sterilizers. Efforts to reduce piglets' mortality rate at maternity phase are of major importance, because this is a critical period of animal life where most of the losses occurs due to infectious diarrhea in the first days of life (14). Death of piglets due to crushing, which primary cause may be organic weakness caused by infectious diarrhea was reported by Koketsu et al.(15). Mannion et al. (16) reduced the presence of bacteria in suspension which were causative agent of diarrhea at swine herds from Ireland using chemical methods. The occurrence of diarrhea in piglets at the maternity stage has a decisive influence at mortality rate, gain of weight and number of rejected animals (14).

Table 3 shows results obtained for parameter total weight at birth, weaning and cumulative gain of weight.

Table 3. Results for total birth and weaning weight and cumulative weight gain for treated and control groups.

Parameter	Control group	Treated group	P value
Total birth weight (Kg)	178.1	254.8	-
Mean birth weight (Kg)	1.51	1.61	0.068
Total weaning weight (Kg)	615.8	985.0	-
Mean weaning weight (Kg)	5.97	6.70	< 0.0001
Cumulative weight gain (Kg)	437.7	730.2	-

Mean weaning weight for control group was 5.97 Kg against 6.70 Kg for treated group, with an improvement of 10.89% for this parameter (P< 0.0001). These results were corroborated with greater cumulative weight gain for piglets from treated group, (730.2 Kg), when compared to control group (437.7 Kg). Similar results were obtained by Vieira (13), with an increase of 15.7% for piglets' daily gain of weight at maternity stage using air sterilizer in swine facilities.

Table 4 shows results of parameters evaluated in a period of 28 days and related to sows and piglets' behavior and odor of the rooms.

Table 4. Results for the parameters defined in score* and totalized in a period of 28 days for sows and piglets behavior, odor of the rooms and their respective means for treated and control groups at the maternity of a commercial swine farm.

Parameter	Control group	Treated group	P value
Total score – sows behavior	111	85	-
Mean daily score- sows behavior	1.32	1.01	< 0.0001
Total score – piglets behavior	84	75	-
Mean daily score- piglets behavior	1.12	1.04	0.463
Total score - odor of the rooms	154	102	-
Mean daily score - odor of the rooms	1.83	1.21	< 0.0001

* Score for sows and piglets behavior: 1- calm, 2- average, 3- agitated
* Score for odor of the rooms: 1- low, 2- average, 3- high

Sows control group behavior mean daily score was 1.32 points, against 1.01, for treated group, (P < 0.0001). Considering piglets' behavior, mean daily score for control group was 1.12 points against 1.04, (P= 0.463). For the parameter odor of the room, mean daily value of control group rooms was 1.83 points against 1.21 (P< 0.0001). Considering the totalized parameters of sows and piglets' behavior and odor of the rooms for treated against control group, these were satisfactory, with sows and piglets of treated group calmer than those from control group and the odor of the room was also reduced (table 4). Efforts to

improve maternity environment facing improvement of zootecnic results are fundamental (17), because sows in healthy environment kill less piglets due to crushing, which is one of the major cause of mortality at maternity during piglets first days of life.

Total food consumed by treated group sows was 2,038.2 Kg with daily mean of 4.54 Kg per sow and by control group was 1,912.5 Kg with daily mean of 4.26 Kg (table 5). There was more consumption on treated group with 125.7 Kg, representing an increase of 6.16% for this item, however, without statistical significance. One of the major challenges for technified swine herds is to increase food consumption at maternity stage (18), because that sows which consume more food, have more milk and their piglets are heavier at weaning.

Table 5. Total food and your respectively mean daily consumed by sows for treated and control groups.

Parameter	Control group	Treated group
Total food consumed (Kg)	1,912.5	2,038.2
Mean daily food consumed (Kg)	4.26	4.54

Each air sterilizer equipment consumed 2 Kilowatts of electric energy in the period of 24 hours, representing a daily cost of US$ 0.238. All 16 equipments had a total cost of US$ 106.62 during 28 days of experiment. Regarding air sterilization cost benefit relation, there was economic gain using the equipment. If it is considered a herd of 200 sows, model of this experiment, with one equipment for each farrowing crate, 42 on total and mean birth of 450 piglets each month, estimated cost to maintain the equipment on during 24 hours would be US$ 279.88 each 28 days. The use of air sterilizer reduced in 45.23% mortality rate of piglets, avoiding death of approximately 26 animals and weaned piglets mean weight were 700 grams heavier. Maternity mortality reduction associated to piglets' weight allows the increase in kilograms of meat produced per sow each year. Heavier animals at weaning will have better performance at following stages, with reduction of mean age for slaughter which confers more earning for swine exploitation.

CONCLUSION

Considering the conditions where the experiment was made, the use of a physical method of air sterilization at the maternity stage has contributed to improve performance of animals mainly in relation to reduction of mortality rate, unspecific diarrheas, increase of weaned piglets weight gain and better environmental quality of a commercial swine farm, with a favorable cost benefit relation.

REFERENCES

1. Wentz I, Bortolozzo F, Brandt G. Hipertermia during estrus may influence the reproductive performance of female pigs. Cienc Rural. 2001; 31: 651-6.

2. Sobestiansky J, Barcellos D, Mores N, Carvalho LF, Oliveira, S. Clínica e patologia suína. 2a ed. Goiânia: Universidade Federal de Goiás; 1999.

3. Karadzhov S, Kesiakova S, Pavlov M. Prophylactic disinfection of the housing for suckling sows under commercial swine-raising conditions. Vet Med Nauki. 1986; 23: 53-8.

4. Bilić V, Habrun B, Barac I, Humski A. Distribution of airborne bacteria in swine housing facilities and their immediate environment. Arh Hig Rada Toksikol. 2000; 51: 199-205.

5. Fan X, Fett WF, Mitchell BW. Effect of negative air ions on Escherichia coli ATCC 25922 inoculated onto mung bean seed and apple fruit. J Food Prot. 2007; 70: 204-8.

6. Scherwing C, Golin F, Guenec O, Pflang K, Dalmaso G, Bini M, et al. Continuous microbiological air monitoring for aseptic filling lines. J Pharm Sci Technol. 2007; 61: 102-9.

7. Walker JT. Use of benchtop steam sterilisers. Br Dent J. 2007; 203: 468-9.

8. Weiner BK, Kilgone WB. Bacterial shedding in common spine surgical procedures: headlamp/loupes and the operative microscope. Spine. 2007; 32: 918-20.

9. Mores N. Diarréia pós desmame em leitões. In: Mini Simpósio do Colégio Brasileiro de Nutrição Animal; 1999, Belo Horizonte. Belo Horizonte; 1999. p.101-5.

10. Suinsoft - Sistemas para Suinocultura; Versão 3.0.7.

11. Zar JH. Biostatistical analysis. 4th ed. Upper Saddle River: Prentice Hall; 1999.

12. Graphpad Instat 3, Copyright Instat; 1998.

13. Vieira RP. A influência de tratamento de ar em maternidades de suínos de alta produção. Airfree. Agro Manual. 2007; 1: 1-5.

14. Ngeleka MJ, Pritchard G, Appleyard D, Middleton M, Fairbrother JM. Isolation and association of Escherichia coli AIDA-I/STb, rather than EAST1 pathotype, with diarrhea in piglets and antibiotic sensitivity of isolates. J Vet Diagn Invest. 2003; 15: 242-52.

15. Koketsu Y, Takenobu S, Nakamuru R. Preweaning mortality risks and recorded causes of death associated with production factors in swine breeding herds in Japan. J Vet Med Sci. 2006; 68: 821-7.

16. Mannion CFC, Leonard P, Lynch B, Egan, J. Efficacy of cleaning and disinfection on pig farms in Ireland. J Vet Rec. 2007; 161: 371-5.

17. Aarnink AJA, Schrama MJW, Heetkamp J, Stefanowska TTT. Temperature and body weight affect fouling of pig pens. J Anim Sci. 2006; 84: 2224-31.

18. Peng JJ, Somes SA, Rozeboom DW. Effect of system of feeding and watering on performance of lactating sows. J Anim Sci. 2007; 85: 853-60.

Recebido em: 29/09/2008
Aceito em: 08/06/2009