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ORAL COMMUNICATION

Growth performance of Bísaro pigs in hoop barn and confinement housing systems

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Additional keywords

Bísaro pig breed.
Average daily gain.
Food conversion ratio.
Production system.

SUMMARY

The goal of this study was to compare the growth performance of growing/finishing pigs housed in a hoop barn system and in traditional confinement. A total of twenty Bísaro breed pigs, with 98.6±5.71 days of age, and 25.4±4.87 kg of BW were used (beginning of experiment). The pigs were equally distributed in two groups: Gr1 – hoop barn (3.0 m^2/pig) with outdoor access (200 m2/pig); and Gr2 - traditional confinement with straw bedding (1.8 m2/pig). Both groups were fed with the same diet. During the next 98 days' period (growing phase) and until pigs reached approximately 80 kg LW, the animals were fed with a concentrate diet. In the finishing phase consisting of a final 70 days period until slaughter, the animals reached between 110-120 kg LW and were fed with concentrate and cornflour. The feed intake per group was registered daily and growth performances were collected every two weeks. During the growing phase no differences (P > 0.05) were observed in the average daily gain (ADG) between Gr1 (0.546±0.10 kg/day) and Gr2 (0.563±0.05 kg/day). However, a higher variability was observed in hoop barn group (CV of 18.1% vs. 8.8% in confinement). Similar results were observed during the finishing phase with ADG of 0.535±0.09 kg for Gr1 and 0.505±0.07 kg for Gr2 (P > 0.05). In both growing and finishing phases, the feed conversion rates (FCR) were 3.11 on the Gr1 versus 3.12 kg/kg on the Gr2, and 3.44 in Gr1 versus 3.53 in Gr2, respectively. Despite the different housing systems, ADG and FCR per period were identical in both systems. To the consumer's point of view, the positive aspects of the hoop barn system, such as the use of uncultivated land, product image and pig welfare, are sustainably attractive and therefore could be further reflected in the market.

Crecimiento de cerdos Bísaros alojados en un sistema *hoop barn* y en confinamiento tradicional

Palabras clave adicionales

Raza Bísara.
Ganancia media diaria.
Índice de conversión.
Sistema de producción.

RESUMEN

El objetivo de este estudio fue evaluar el crecimiento de cerdos alojados en un sistema hoop barn, en comparación con el confinamiento tradicional. Veinte cerdos de raza Bísaro, con 98,6±5,71 días de edad y 25,4±4,87 kg de peso vivo, se distribuyeron aleatoriamente en dos grupos: Gr1 - hoop barn (3,0 m^2/cerdo) con acceso al exterior (200 m2/cerdo); Gr2 - confinamiento tradicional con cama de paja (1,8 m^2/cerdo). La dieta fue igual para ambos grupos. Durante la fase de crecimiento (98 días) y hasta 80 kg de peso vivo, los animales fueron sometidos a una dieta con concentrado. A continuación, durante 70 días y hasta el sacrificio (110-120 kg de peso vivo), también estaba disponible harina de maiz. La ingesta de alimento por grupo se registró diariamente y los pesos vivos individuales se recogieron por quincena. La ganancia media diaria (ADG) durante la fase de crecimiento fue de 0,546±0,10 kg (Gr1) y 0,563±0,05 kg (Gr2) sin diferencias significativas (P> 0,05), pero con mayor variabilidad en el sistema hoop barn (CV de 18,1% vs. 8,8% de confinamiento). En la fase de acabado, el ADG fue 0,535±0,09 kg (Gr1) y 0,505±0,07 kg (Gr2) (P> 0,05). La eficiencia de conversación alimenticia (FCR) en las fases de crecimiento y de acabado fue de 3,11 kg/kg (Gr1) y 3,12 kg/kg (Gr2) y 3,44 (Gr1) y 3,53 (Gr2), respectivamente. A pesar de las diferencias en el alojamiento, la ADG y el FCR fueron idénticos en ambos sistemas de producción. Para el consumidor, las ganancias asociadas con el sistema hoop barn, como el uso de tierras no cultivadas, el bienestar del cerdo y la imagen del producto, son atractivas y por lo tanto, esto se reflejará en el mercado.

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INTRODUCTION

Meat from Bísaro pig is used to produce a great diversity of traditional meat products, and some of them are Protected by Certified Quality System, like: Protected Designation of Origin (PDO), Protected Geographical Indication (PGI) and Traditional Specialty Guaranteed (TSG). Currently, there are approximately 3962 (year 2014) Bísaro sows registered in the herd book. The farms have an average of 30 sows (ANCSUB, 2016) raised in traditional family farms (50%) and kept in semi-intensive outdoors systems or semi-extensive (Santos Silva & Tirapicos Nunes, 2013). The nature of the raw feeds used in the traditional diets is a limiting factor of the herd size. Thus, the main weakness of this production system is the very small scale of the pig farms, and the rudimentary buildings and animal facilities, which are poorly dimensioned, limiting the farms productivity and possibly impairing animal welfare. Typically, fattening of Bísaro pigs to obtain high quality meat products includes two growing phases: first, a fast/moderate growth up to 70-75 kg live weight (LW), and second, a fattening/finishing phase until 120-160 kg LW, with variable diets depending on the availability of local food resources on each farm and region, such as: flour cereals, fruits, vegetables, tubers, grass chestnuts and acorns (Santos Silva and Tirapicos Nunes, 2013). The building design for pigs influences the efficiency and quality of pig production. Facilities and housing factors influence both the environment and animal welfare and growth performance, making this issue a key point for efficient management, quality and food safety (Araujo et al., 2016). As alternatives to improve the traditional system, intensive outdoor, or semi-confined housing with the incorporation of external input, for instance cereals and food concentrates, have been developed. The accommodations used in the traditional system are very different and must be adapted. The location, dimensions and materials must meet the metabolic, thermal and behavioural needs of the animals, according to physiological, geographical and environmental conditions of each region. Thus, a growing interest has been shown in outdoor swine production systems due to the lower initial investment cost such as facilities, buildings and equipment (Araujo et al., 2016; Cerqueira et al., 2016). At the same time, concerns with animal welfare and awareness of niche marketing opportunities have increased the interest in the production of free-range animals (McGlone, 2001). The objective of this experiment was to develop, test and demonstrate an alternative and sustainable building system for fattening and finishing of Bísaro pigs, Hoop Barn with free access to open air, respecting the good production practices and animal welfare, with benefit to the environment, occupying marginal or abandoned land, giving it productive use and added value in a sustainable way.

Table I. Chemical composition of the diets in the two phases (on dry matter basis) (Composición química de las dietas de las dos fases, basado en materia seca)

Chemical composition (%)	Growing	Finishing
Crude Protein	16.31	14.34
Ash	4.59	4.01
Fat	4.44	4.4
Crude Fibre	4.29	4.29
Ca	0.63	0.56
P	0.53	0.46
Lysine	0.84	0.71
Methionine	0.29	0.26

MATERIALS AND METHODS

Animals and experimental design

Twenty Bísaro pigs (10 castrated males and 10 females) of 98.6±5.7 days of age and 25.4±4.87 kg LW were equally distributed in two production systems. Group 1 (GR1) consisted of ten pigs in a hoop barn of 30 m^2 (3 m^2 /pig) with free access to an outdoor area of 2000 m^2 (200 m^2 /pig). Group 2 (GR2) included ten pigs in a barn of 18 m^2 traditional confinement on straw bed (1.8 m^2 /pig). Temperature data loggers (Tinytag ultra 2-TGU-4500) were fixed at an approximate height of 1.5 m in the center of the hoopabarn and the barn. The monitors recorded the temperature at intervals of one hour during the whole experimental period (168 days).

Feeding regime

In both housing systems, the feeding regime was the same for all animals **(Table I)**. During the growing phase (98 days' period) and until 80 kg LW, animals were submitted to a starter concentrate diet for 21 days (1.5 kg/pig/day) and substituted with concentrate growth diet (1.5 kg/pig/day) and corn meal (0.4 kg/pig/day) until the end of this phase. During the finishing phase of the next 70 days and until slaughter at 110-120 kg LW, the concentrate growth diet was maintained, and the corn meal was increased (0.6 kg/pig/day). The chemical composition of diets is shown in **Table I**.

Performances

Every 14 days, all animals were individually weighted. During the growing and finishing phases, feed consumption per group was registered on a daily basis. Growing performances were evaluated calculating the Average Daily Gain (ADG, kg/day) and the Food Conversion Rate (FCR, Kg food/kg LWG).

Statistical analyses

Treatment effects on performance traits were assessed by analysis of variance using the program IBM-SPSS for Windows (version 22.0). Model (1) was used for, age, LW and ADG.

$$Y_{ij} = \mu + S_i + e_{ij} \qquad (1)$$

where Y_{ij} = is the response variable of the jth animal subjected to the ith system, μ is the overall mean, and eij is the residual error.

Initially, the statistical model included the effect of system and sex as fixed factors. However, as the sex didn't affect the growth, it was eliminated from the initial model.

Table II. Initial age and weight of pigs at the beginning, end of growing and end of finishing periods and daily gain, according to housing system (Edad inicial y peso de los cerdos al inicio, final del crecimiento y final del acabado y ganancia diaria según el sistema de alojamiento).

	Hoopbarn				Traditional confinement				
	Avg±SD	Min	Max	CV (%)	Avg±SD	Min	Max	CV (%)	Sig.
Beginning of experiment									
Age (days)	97.2±7.22	81.0	103.0	7.43	100.0±3.50	91.0	103.0	3.50	NS
LW (kg)	25.4±5.69	18.1	34.7	22.40	25.32±4.22	20.3	31.7	16.67	NS
Growing phase									
Age (days)	198.0±3.50	189.0	201.0	1.77	195.2±7.20	179.0	201.0	3.70	NS
LW (kg)	80.7±14.48	61.4	113.1	17.95	80.5±7.73	71.1	92.7	9.61	NS
ADG (kg/day)	0.564±0.10	0.44	0.80	18.07	0.563±0.05	0.48	0.64	8.84	NS
Finishing phase									
Age (days)	268.0±3.50	259.0	271.0	1.30	265.2±7.20	249.0	271	2.72	NS
LW (kg)	118.1±17.81	92.2	156.1	15.08	115.8±9.11	98.6	130.0	7.87	NS
ADG (kg/day)	0.535±0.09	0.400	0.668	16.71	0.505±0.07	0.364	0.604	13.69	NS

RESULTS

The average temperature was of 11.2±4.1 ºC and 13.2±5.0 ºC in the hoop barn system, during the growing and finishing phases respectively, and 14.4±2.5 ºC and 16.4±2.9 ºC in the barn of the traditional system during the growing and finishing phase respectively, with higher variability in the hoop barn **(Table III)**. Results of animal LW and ADG from the beginning of the experiment, growing and finishing phases are summarized in **Table II**. The growth performance and ADG were not affected (P>0.05) by the housing system, during both the growing and the finishing periods. However, a higher variability of ADG was found for pigs hoop barn than in traditional confinement. The FCR was 3.11 kg/kg and 3.92 kg/kg for hoop barn during the growing and finishing phases, respectively. Concerning the traditional confinement FCR was 3.12 kg/kg and 4.15 kg/kg, growing and finishing phase respectively. In both systems, this ratio was higher in the finishing phase.

DISCUSSION

The housing and nutritional factors influence the pig growth, and therefore have a direct relation with the quantity and quality of the meat produced on farm (Iglesias et al., 2014). The results obtained in this work were similar to those found within the PAMAF project (PAMAF, 2001) with Bísaro breed which reported a relatively slow growth rate of 0.549 kg/day, in the same range of weights. Santos Silva et al. (2000) did not find significant differences between the first growing period, 30-96 kg, with a ADG of 0.559 kg/day, and the finishing period, 96-150 kg, with ADG of 0.534 kg/day. In this study, the FCR was better during the first growing period, 3.77 kg/kg, than finishing phase, 5.45 kg/kg. In the present study, the animals were slaughtered at lower LW (120 kg), with maximum FCR in finishing phase of 3.92 kg/kg and 4.15 kg/kg for hoop barn and barn, respectively. On the other hand, Demori et al. (2012) in a meta-analysis study concluded that the outdoor productive system reduced the ADG of pigs by around 2% and increased the FCR by 3% compared to the classic intensive system. Millet et al. (2005) and Lebret et al. (2008) explained that the negative interferences observed in the performance of the unconfined pigs are related to the higher energy expenditure of the animals raised in these systems. Others authors (Lambooij et al., 2004; Strudsholm and Hermansen 2005; Hansen et al., 2006) refer that the enrichment of the environment as a stimulus of exploratory behaviour must be considered to explain the interference of the breeding system on the performance characteristics.

However, in this study no differences were observed in the ADG of pigs reared in between hoop barn with outdoor area and traditional barn housing systems, indicating that no negative effect of unconfined system was found on pig performance. During this study the meteorological conditions were reasonable, so the differences on ADG were not detected in this experiment. The place was pleasant as animals were placed in an outdoor natural environment and the welfare issues in the hoop barn system were fulfilled (Araújo et al., 2016). In fact, the animals in the hoop barn system have never been exposed to extreme

Table III. Temperature (ºC) on hoop barn and barn (Temperatura (ºC) en le hoop barn y en alojamiento tradicional)

Phase	Hoopbarn				Barn			
	Avg±SD	Min	Max	CV (%)	Avg±SD	Min	Max	CV (%)
Growing	11.2±4.14	0.4	22.4	37.1	14.4±2.46	7.2	23.7	17.0
Finishing	13.2±5.04	2.3	34.1	38.2	16.4±2.90	9.0	26.7	17.7

weather conditions. The present work was conducted on late autumn/winter (growing phase) and spring (finishing phase). The mean temperature **(Table III)** in growing phase in both hoop barn (11.2 ºC) and barn (14.4 ºC) was lower than the range 15,5-24°C recommended by the National Pork Board (2002) for pigs between 34-68 kg LW. Relatively to the finishing phase the mean temperature inside the hoop barn (12.2 ºC) and barn (16.4 ºC) is inside the range of 10-24°C recommend for finishing pigs (68-100 kg; National Pork Board, 2002).

In studies of Honeyman (2003) and Strudsholm & Hermansen (2005), observed growth performances within the same order of values as those observed in the present experiment. Other study carried out in the summer season have shown a higher growth rate for outdoor than for indoor reared pigs (Gentry et al., 2002). However, the climatic and seasonal conditions can be quite different in different regions of the terrestrial globe. In another experiment Santos Silva et al. (2006) fed Bísaros pigs in different conditions (seasons and diets) and recorded an interaction between the type of diet and the season of the year.

CONCLUSIONS

The results obtained in this study suggest that outdoor system including a hoop barn and a large outdoor area can be a suitable alternative to the traditional production system and housing system represents a viable and efficient solution for the growing and finishing Bísaro with environment benefits as occupying marginal or abandoned land, giving it productive use and added value in a sustainable way.

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