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EFFECT OF FEEDING DINNING ROOM AND KITCHEN WASTE ON GROWTH PERFORMANCE OF GROWING PIGS

[EFECTO DEL DESPERDICIO DE COMEDOR Y COCINA EN EL DESEMPEÑO PRODUCTIVO DE CERDOS EN CRECIMIENTO]

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SUMMARY

This research used 41 growing backyard piglets (11.47 ± 1.2 kg BW) fed for 22 d and assigned at random to three treatment (T) groups, respectively (T1 to T3) with three repetitions. The proportion of commercial concentrate (CC) to kitchen waste (DW) was: T1, 100:0; T2, 50:50 and T3, 0:100. Diets contained: T1, 17.3, 13.6 and 16.3% CP and 3,321, 3,526 and 4,011 McCall/kg of ME, respectively. Weight gain, carcass characteristics, minerals and metabolites in blood serum were evaluated. The weight gain, slaughter weight, hot and cold carcass weight, hot and cold carcass yield, rib eye area and back fat thickness were not affected by DW (P> 0.05). The cuts of leg shoulder and rib were not affected by treatment (P> 0.05) for dry matter, ash and crude protein content. The increase in DW reduced ether extract content of leg and rib (P <0.05) but not in shoulder (P> 0.05). The concentration of Ca decreased with DW inclusion (P <0.05). No treatment effect was observed in blood metabolites (P> 0.05). It is concluded that feeding with DW the backyard growing pig do not affect growth performance or quality of meat.

Key words: Dining Waste; growth; carcass; blood serum; piglets.

RESUMEN

Esta investigación empleó 41 lechones de traspatio en crecimiento (11.47± 1.2 kg) alimentados por 22 d y asignados al azar en tres tratamientos (T), respectivamente (T1 a T3) con tres repeticiones. La proporción concentrado comercial (CC) a desperdicio de comedor (DCC), fue: T1, 100:0; T2, 50:50 y T3, 0:100. Las dietas respectivamente (T1 a T3) contenían, 17.3, 13.6 y 16.3% PC y 3.321, 3.526 y 4.011 Mal/kg de EM. Se evaluó incremento de peso, características de la canal, minerales y metabolitos en suero sanguíneo. El incremento de peso, peso al sacrificio, peso de la canal caliente y frío, rendimiento en canal caliente y fría, área del ojo de la chuleta y espesor de grasa dorsal no fueron afectados por los DCC (P>0.05). El contenido de materia seca, ceniza y proteína cruda en los cortes de pierna, paleta y costilla no se afectó por el tratamiento (P>0.05). El incremento en DCC redujo el EE en pierna y costilla (P<0.05) pero no en paleta (P>0.05). La concentración de Ca se redujo con los DCC (P<0.05). No se observó efecto de tratamiento en metabolitos sanguíneos (P>0.05). Se concluye que alimentar cerdos de traspatio en crecimiento con DCC no presenta ningún efecto sobre la ganancia de peso o la calidad de la carne.

Palabras clave: Desperdicio de comedor; crecimiento; canal; suero sanguíneo; lechones.

INTRODUCTION

Backyard pig production is a very familiar practice, where the activity operates as a system of saving in the rural field. In addition, this activity has had great acceptance and generalization for its beneficial results. In this activity the domestic and productive units are physically integrated. This means a social activity and important source of income in the rural family (Santamaría et al. 2011). They produce most of the backyard pig inventory under rustic conditions and are producers with low income (SAGARPA, 2009).

The shortage in feed as well as the reduced supply and high cost of ingredients used in animal feeding; forced to look for promising alternatives for the care of livestock production species. On the other hand, the accumulation of garbage or waste increases and becomes ecological problem in the localities, there which, in many Asian countries, the accumulation of waste and nutrients causes a great imbalance. Therefore, the technological development in the use of wastes of food for humans and feed for animals will contribute to improve the self-sufficiency of food, which would correct the imbalance by the accumulation of nutrients and make a more sustainable agriculture (Kawashima, 2004; Chittavong *et al*. 2012; Yi, 1999).
Accumulation and environmental pollution caused by these waste requires eliminating the waste of food through the feeding of animals. Similarly, results from the use of waste, plant by-products and animals in animal feed have been reported. As an example in the Caribbean (Domínguez, 1997) recycling this material to be an attractive option (Westendorf *et al*. 1996); in the American continent (Aguilar, 2011; Kornegay *et al*. 1970; Myer *et al*. 1999; Pérez, 1997).
The backyard pig production is distributed for the supply of micro-regional markets or to self-sufficiency (SAGARPA, 2009). Therefore, the objective of this research was to evaluate the behavior of backyard growing piglets fed with waste from dining room and kitchen (DW) through the daily weight gain, measures zoometric, carcass traits, mineral and metabolites in blood serum.

MATERIALS AND METHODS

This study was conducted in the metabolic unit for research of the Universidad Autónoma Agraria Antonio Narro, Buenavista, Saltillo, Coahuila, Mexico. Which is geographically located at 25 ° 22 ' North latitude and 101 ° 22 ' length West, with an altitude of 1742 meters above sea level, average temperature of 17.7 ° C and average annual precipitation of 225 mm (García, 1987).

We used nine pens of concrete equipped with automatic waterers and feeders that were disinfected with chlorine and lime (calcium oxide) 15 days prior to initiation of the investigation. It was used 41 piglets in the stage of growth with 11.47±1.2 kg of LW from the Backyard Pigs Program of the University. At the beginning of the evaluation, the piglets were weighed and this practice was repeated every 8 days until the end of the evaluation. The previously identified animals were distributed at random in nine groups and formed three treatments with three repetitions each.

It was evaluated as a feed a commercial concentrate (CC) and dining room and kitchen waste (DW), forming three treatments with three replications. Each repetition was considered an experimental unit. Treatments contained T1 100:0; T2 50:50 and T3, 0:100 CC:DW, respectively. These diets were established according to the system used by small backyard pig producers. Feed was offered such as collected (CBT) by animal: T1, 1.2; T2, 0.600 + 2.0; T3, 4.0 kg, all in wet basis. The DW had 30% of DM in average. According to the concentration of dry matter in the diets was calculated daily feed consumption in dry basis of 1.2 kg per day per animal for treatments T1, T2 and T3. The feed was offered once per day and contained (% CP and Mcal/kg of ME); T1, 17.3% and 3,261; T2, 13.6% and 3,526; T3, 16.3% and 3,620. The average daily gain (ADG) was calculated taking into account the difference between final and initial weight divided by the days of the experiment.

Feed samples were dried at 60° C in an oven until constant weight; then samples were ground in a Willey mill with 2 mm diameter mesh. These samples were analyzed to determine dry matter (105° C), crude protein (N x 6.25), ether extract, crude fiber and extract free nitrogen, according to AOAC (1997). The metabolizable energy (ME) was obtained by the equation reported by National Research Council (NRC, 1998).

At the end of the experiment the piglets were measured (cm) for: height at the cross, (from the ground to the top of the cross); length of tubers, (from the joint escapula-humeral to the top of the rump); chest circumference (from the base of the cross going through the sternum ventral base and then to the base of the cross), forming a circle straight around the flat sacks.

Subsequently, two piglets in each replicate chosen at random (6 per treatment) were sacrificed humanely to record the weight at sacrifice and hot carcass weight (without considering the weight of the head, viscera, legs and blood, according to the system practiced in the region) and determine the hot carcass yield (hot carcass weight as percent of the live weight); cold carcass weight and cold carcass yield (cold carcass weight as percent of the live weight at sacrifice); the rib eye area using grid of IOWA and back fat thickness between the seventh and eighth rib at a seven centimeters of the spine according to the instructions of operation of the Draminski back fat scanner. From the carcass were obtained samples to perform chemical analysis of dry matter, crude protein, ash and ether extract (AOAC, 1997).

At the end of the experiment, blood samples were obtained. For this sampling were obtained at random two piglets from each repetition (6 per treatment). These samples were centrifuged at 2000 g for 15 minutes. The obtained serum was analyzed in a Spectronic ® 20 GenesysTM model 4001 - 4 spectrophotometer, USA; to determine metabolites preparations; Glucose, method Trinder. GOD-POD; creatinine, Jaffe method without deproteinization; cholesterol, method CHOD-PAD and hemoglobin, ICSH standardized method and an absorption spectrophotometer Atomic Varían series AA-1275, Australia, Were identified minerals previously prepared; P, method phosphomolybdate; CA, Orto method Cresoftaleina; Mg, Xilidil blue method; CU and Zn, serum diluted in water).

The data were analyzed in a completely randomized design for three treatments and an equal number of repetitions (3) each as an experimental unit (Stell and Torrie, 1986). Applying the system of statistical analysis (SAS ® version 9.0), with the procedure General Linear Models (GLM).

RESULTS AND DISCUSSION

The DW was variable in its nutrient content (PC, EE, FC, ashes, ELN) and energy, showing wide ranges between the evaluated feed samples. The average daily gains (ADG) of the growing piglets are showed in table 1. The DW did not affect ($P \geq 0.05$) daily weight gain. The average daily gain (ADG) during the experiment was 0.261, 0.310 and 0.264 kg/day for T1, T2 and T3 respectively. Although there was no significant difference, numerically the highest GDP was for 50:50 CC:DW T2, had 47 g more on increase of weight than piglets fed diets containing 100 CC and 100 DW.

The consumption CP was 0.190, 0.163 and 0.196 kg and energy was 3.586, 4.231 and 4.344 Mcal ME/day per animal for treatments T1, T2 and T3 respectively. Consumption of CP obtained in this study is lower than those reported by (NRC, 1998); which animals of this weight and age should consume 0.209 kg of CP. However, ME consumption per day was exceeded in all diets. Therefore, the feeding system commonly used by the backyard pig farmer offers lower CP and higher ME concentration (NRC, 1998).

The variable content of nutrients in DW was its limitation. Diets containing DW (T2 and T3) used in this work were high in fat 7.7 and 14.5%. Situation that raises the ME content in the diet. In addition, this situation can alter the energy:protein relationship and it may be necessary to increase the intake of dietary protein. Because it is necessary to maintain an appropriate relationship energy:protein for suitable responses in growth performance (Westendorf et al. 1998). Especially with young pigs at growing stage, and may be risk of protein restriction if diets are not well complemented (Allee and Hines, 1972).

However, the dried residue of restaurants as feed has the potential to obtain a nutritious product for pigs, and also offers a viable option as solid waste (Myer et al. 1999). On the other hand, a diet adequate in protein and amino acids is critical when using grain distillery (Lynn et al., 2009) or dehydrated waste of restaurants (Myer et al., 1999) for an optimal response in pigs.

The statistical analysis for carcass characteristics, the results do not show significant difference ($P \geq 0.05$) among treatments. However, it was noted that animals fed with 50:50 ratios were heavier, followed by piglets fed with T1, 100:00 and finally 00:100 CC:DW (table 1).

The weight of pigs at slaughter was 17.8, 22.7 y 16.3 kg, hot carcass weights were 10.3, 12.8, and 9.3 kg; as a result, the hot carcass yield was: 57.9, 56.4, and 57.1%. The weight of the cold carcass was 9.7, 12.0, and 8.0 kg, while the cold carcass yields were 54.5, 53.0 and 49.1%, respectively. It is noted that the behavior of piglets is largely dependent on the quality of the diet (Colina-Rivero *et al*. 2010).

Something important needed have mention is that the diet CC: DW 50:50 offered to piglets from T2. These piglets in general had the best performance. It is probable that the wet condition of DW mixed with CC improved the feed utilization or by associative effect among them. Since the animals eat to meet caloric requirements, but if the diet is diluted in water, pigs will consume a greater volume (Church *et al*. 2010).

In animals consuming waste of cafeteria, the dietary water intake was significantly higher in the group fed with waste of cafeteria and they drank much less water, but total intake did not differ. The pig shows ability to regulate their balance of water, regardless of the water content of the diet (Westendorf *et al*., 1998).

The area of rib eye (cm^2) and back fat thickness (mm) were not statistically different (P≥0. 05). However, the largest area in rib eye was animals fed with 50:50 CC:DW as opposed to piglets fed diets with CC or DW. The back fat thickness presents the following values 16.4, 15.3 and 13.9 mm for T1, T2 and T3 respectively (table 1). In a study involving 39 native without hair male pigs (CCP) with an initial BW of 6.9 ± 2.38 kg and approximately 40 days of age; the weight of carcass and back fat measured before and after slaughter increased as the slaughter weight increased (Santos-Ricalde *et al*. 2011).

To statistically assess the chemical composition of the carcass was no significant difference (P≥0. 05) on the determination of DM, ash and CP of leg, rib, and arm. However, the content of EE showed significant difference (P≤0. 05) between treatments in the leg and rib cuts, but without significant difference (P≥0. 05) on the arm cut. The significance of the EE content in leg and rib in the T1 100:00 CC:DW is not biologically explained. Since the higher content of EE in the diet was in the diets of T2 and T3 (table 2).

This regard Braña, (2011), believes that the main components that make up the empty weight of a pig vary with age; so, to get from the birth to weight of sale, a pig will need to increase your size 80 times. Therefore the growth of a part of the body of the pig always holds proportion with the rest of the body. For example, bone mass always keeps proportion with muscle mass. However, fat is the exception to the rule. The growth of fat is extremely variable and does not keep any proportion with muscle mass. Corroborating this, pigs with 1.4, 7, 28 and 112 kg BW will have 2, 15, 12, and 25% of fat; but CP remains constant at 17.0% on average. Very different from what happens with lean tissues, the proportion of fat in the body, shows greater variability between pigs (Lance *et al*. 2001).

Since Westendorf *et al*. (1998) and Kornegay *et al*. (1970), indicate that the carcass quality of pigs fed with waste of cafeteria is similar to the pigs who receive traditional diets.

External measurements in cm (height, length of tubers and chest circumference) of piglets at the end of the research were not affected (P ≥ 0.05) by the addition of the DW in the ration (table 3). For the treatments (100:0), (50:50) and (0:100) CC:DW the following measures, (cm) were obtained, respectively: height to the cross, 38.5, 37.3 and 36.4; length of tubers, 39.0, 39.8 and 36.4; thoracic circumference, 57.2, 54.4 and 55.1. In this regard the formation of bone mass of the pig is related and keeps proportion with the formation of muscle mass. Unless pigs of different breeds being compared. But the performance of the young pig is more effect of maternal genetics than the own genetic (Braña, 2011).

Table 1. Growth performance of piglets from backyard fed with waste of dining room and kitchen

	Waste of dining room and kitchen (%)				
	0	**50**	**100**		
Determination	**T1**	**T2**	**T3**	**SEM**	**P≥F**
Number of repetitions	3	3	3		
Average daily weight, kg	0.261	0.301	0.264	0.035	0.61
Weight at slaughter, kg	17.8	22.7	16.3	3.99	0.541
Hot carcass weight, kg	10.3	12.8	9.3	2.179	0.543
Cold carcass weight, kg	9.7	12.0	8.0	2.4	0.537
Hot carcass yield (%)	57.9	56.4	57.1	3.568	0.976
Cold carcass yield (%)	54.5	53.0	49.1	5.02	0.757
Rib eye area (cm^2)	24.3	27.0	23.3	4.815	0.829
Back fat thickness (mm)	16.4	15.3	14.9	1.341	0.539

SEM = standard error of the mean. P≥F = Probability

Table 2. Chemical evaluation of the carcass from backyard piglets fed with waste of dining room and kitchen.

	Waste of dining room and kitchen (%)				
	0	**50**	**100**		
Determination	**T1**	**T2**	**T3**	**SEM**	**P≥F**
Leg					
Total dry matter	23.6	23.7	22.3	1.23	0.691
Ash	1.1	0.9	1.1	0.11	0.417
Crude protein	18.2	19.6	18.4	2.40	0.910
Ether extract	7.3	4.8	1.7	0.99	0.020
Rib					
Total dry matter	24.1	25.8	22.8	2.51	0.718
Ash	1.0	1.0	0.9	0.08	0.787
Crude protein	19.8	19.5	19.0	1.53	0.929
Ether extract	17.3	8.8	2.3	2.46	0.015
Arm					
Total dry matter	24.2	22.2	23.1	1.44	0.642
Ash	1.0	1.2	1.0	0.06	0.062
Crude protein	21.2	19.7	18.9	0.66	0.128
Ether extract	5.2	6.7	3.7	1.33	0.354

SEM = standard error of the mean. P≥F = Probability

The concentration of minerals: P, Mg, Cu, and Zn in blood serum had no significant difference (P≥0. 05) among treatments receiving diets based on C, C: DW and DW; with the exception of the Ca which had significant difference (P≤0. 05; Table 4). It is important to highlight that the concentrations of all measured electrolytes were within the reference range for pigs and that the change mentioned in the electrolyte status did not affect physiological homeostasis of animals.

Bone tissue is the major user of these three elements Ca, P and Mg, because it contains 23% of mineral substances. Nevertheless, these requirements are particularly important during growth, last month of gestation and lactation. However, the lack of these elements in piglets presents a detention of growth and rickets by ossification disorders (Zert, 1969).

Most natural feeds are deficient in one or more mineral elements or they are not in balance; diets of pork almost always require specific elements that are rich in calcium or phosphorus. Virtually existing in all supplements calcium is readily absorbed from the gastrointestinal tract of the pig. Conversely, the phosphorus present in the majority of plant products is in the form of phytate (phytic acid) that are not decomposed effectively in the gastrointestinal tract (Rincker *et al*. 2005).

Table 3. Body development in backyard piglets fed with waste of dining room and kitchen.

	Waste of dining room and kitchen (%)				
	0	**50**	**100**		
Variables (cm)	**T1**	**T 2**	**T3**	**SEM**	**P≥F**
Height to the cross	38.5	37.3	36.4	1.982	0.759
Length of tubers	39.0	39.8	36.2	3.2	0.721
Chest circumference	57.2	54.4	55.1	3.086	0.804

SEM = standard error of the mean. P≥F = Probability

Table 4. Mineral concentration in serum of backyard piglets fed with waste of dining room and kitchen.

	Waste of dining room and kitchen (%)					
	0	50	100			
Determination (mg/dl)	**T1**	**T2**	**T3**	**SEM**	**P≥F**	**Normal levels (mg/dl)***
Phosphorus	3.30	2.86	3.96	0.09	0.073	1.8 – 3
Calcium	9.83	7.88	9.35	0.37	0.023	9.3 –11.5
Magnesium	4.96	4.77	4.94	0.3	0.894	2.3 – 3.5
Copper	0.05	0.06	0.06	0.01	0.751	0.7 – 1.4
Zinc	0.12	0.11	0.15	0.01	0.118	0.5 – 1.2

SEM = standard error of the mean. P≥F = Probability
*Merck, (1991)

The concentration of metabolites (glucose, creatinine, cholesterol and hemoglobin) in blood serum of growing piglets fed diets based on DC and DW were not statistically different (P≥0. 05; Table 5). Therefore, the concentration of metabolites was not affected by the addition of DW.

In this study all metabolites in blood serum concentrations were within the normal range except hemoglobin (Merk, 1991). Similar result was obtained by Aguilar, (2011), by feeding piglets in initiation with waste of dining room and kitchen (DW); this suggest that the DW does not affect the concentration of metabolites and hence does not affect the metabolic pathways of these animals.

Other researchers like Colina *et al*. (2009) used meal of pijiguao (*Batris gasipaes* H:B.K.) (HP) plus synthetic lysine; they evaluated hematological parameters in pigs. The addition of 25% HP and lysine to diets did not affect the hematological parameters.

CONCLUSIONS

According to results obtained in this research it is concluded: feeding growing pigs with concentrated (CC) or waste from dining room and kitchen (DW), does not affect the behavior of the piglets. Similarly, the concentration of metabolites and minerals in blood serum were not different with exception of Ca with lower concentration in blood serum in the group 50:50 (T2). Investigations indicate that DW has nutritional value as indicated by the profile of nutrients; the quality of meat from pigs fed with DW has adequate chemical quality. The limiting of DW is its high moisture content, which could reduce the dry matter intake. These results indicate that waste from dining room and kitchen has good nutritional value and may be useful in the diet. The positive effects of the DW in the phase of growth of pigs and its influence on biochemical parameters were demonstrated in this work.

Table 5. Concentration of metabolites in serum of backyard piglets fed with waste of dining room and kitchen.

	Waste of dining room and kitchen (%)					
	0	50	100			
Variables (mg/dL)	**T1**	**T2**	**T3**	**EE**	**P≥F**	**Normal levels* (mg/dL)**
Glucose	75.6	82.2	75.0	19.4	0.959	66.4-116.1
Creatinine	2.1	2.2	2.2	0.1	0.719	0.8 – 2.3
Cholesterol	121	92.5	109.7	22.0	0.676	81.4-134.1
Hemoglobin	14.8	12.7	16.7	2.11	0.533	9 – 13

EE = Error estándar de la media. P≥F = Probabilidad
*Merck, (1991)

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