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Performance and behavior of piglets fed diets with different metabolizable energy levels

Desempenho e comportamento de leitões alimentados com dietas com diferentes níveis de energia metabolizável

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Highlights

The number visit and duration feed is influenced of level energy metabolizable diet.
Level 3.3 to 3.6 Mcal.kg^{-1} ME do not affect piglet-weaned performance.
The energy metabolizable of the diet influenced the ingestive behavior.

Abstract

This study evaluated the effect of different metabolizable energy (ME) levels in diets on digestibility, performance, and feeding behavior of weaned piglets. A digestibility study to determine ME levels was performed using 12 male piglets with 11.5 ± 0.5 kg body weight (BW), in a cross-over design fed with different ME levels (treatments). In the performance study were used 64 female piglets with 7.5 ± 0.8 kg BW, in a randomized block design with four treatments (3.30, 3.40, 3.50, and 3.60 Mcal.kg^{-1} ME levels), and feeding program with three phases (pre-initial I, pre-initial II, and initial). For feeding behavior, four pens of each treatment were monitored with cameras. The crude-protein digestibility coefficient reduced as dietary ME level increased ($P < 0.05$). In pre-initial I animal performance was not influenced ($P < 0.05$) by ME diet levels, and in the pre-initial II and initial phases, increases in ME caused quadratic (r^2 0.99) and linear (r^2

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0.99) effects on daily feed intake, respectively. When ME levels increased, feed conversion ratio decreased linearly in the pre-initial II phase (r^2 =0.98), and quadratically in the initial phase (r^2= 0.99). The number and duration of feeder visits linearly decreased as the diet energy levels increased ($P <0.05$). Weaned piglets can regulate feed intake according to dietary ME levels. The performance of weaned piglets can be maintained using diets containing metabolizable energy levels between 3.30 at 3.60 Mcal.ME.kg^{-1} if the ratio of nutrients to energy is maintained constant.The feed intake behavior of weaned piglets is influenced by increases in dietary metabolizable energy levels evaluated, resulting in fewer and shorter visits to the feeder.

Key words: Dietary energy. Feed regulation. Nutrition. Swine.

Resumo

Este estudo avaliou o efeito de diferentes níveis de energia metabolizável (EM) em dietas sobre a digestibilidade, desempenho e comportamento alimentar de leitões desmamados. Um estudo de digestibilidade para determinação dos níveis de EM foi realizado com 12 leitões machos com 11,5 ± 0,5 kg de peso corporal, em delineamento cruzado, alimentados com diferentes níveis de EM (tratamentos). No estudo de desempenho foram utilizadas 64 leitões fêmeas com peso corporal de 7,5 ± 0,8 kg, em delineamento de blocos casualizados com quatro tratamentos (níveis de 3,30, 3,40, 3,50 e 3,60 Mcal.kg^{-1} ME), e programa de alimentação com três fases (pré- inicial I, pré-inicial II e inicial). Para o comportamento alimentar, quatro baias de cada tratamento foram monitorados com câmeras. O coeficiente de digestibilidade da proteína bruta diminuiu com o aumento do nível de EM da dieta ($P <0,05$). No pré-inicial I o desempenho dos animais não foi influenciado ($P <0,05$) pelos níveis da dieta de EM, e nas fases pré-inicial II e inicial, o aumento de EM causou efeitos quadráticos (r^2 0,99) e lineares (r^2 0,99) na alimentação diária ingestão, respectivamente. Quando os níveis de EM aumentaram, a conversão alimentar diminuiu linearmente na fase pré-inicial II (r^2 = 0,98), e quadraticamente na fase inicial (r^2 = 0,99). O número e a duração das visitas aos comedouros diminuíram linearmente à medida que os níveis de energia da dieta aumentaram ($P <0,05$). Leitões desmamados podem regular o consumo de ração de acordo com os níveis de EM da dieta, o desempenho de leitões desmamados pode ser mantido usando dietas contendo níveis de energia metabolizável entre 3.30 a 3.60 Mcal.EM.kg^{-1} se a proporção de nutrientes para energia for mantida constante. O comportamento de consumo de ração de leitões desmamados é influenciado pelo aumento nos níveis de energia metabolizável da dieta avaliados, resultando em menos e mais curtas visitas ao comedouro.

Palavras-chave: Energia da dieta. Nutrição. Regulação alimentar. Suínos.

Introduction

Voluntary feed intake by farm animals is one of the main determinants of performance and body composition. Among the factors regulating swine feed intake are genetic background, health status, environment, and diet characteristics (National Research Council [NRC], 2012). Pigs can regulate feed intake within certain limits, aiming to meet their nutritional demands (Ndou et al., 2013).

The ability to adjust feed intake by dietary energy levels is well documented for pigs in growing and finishing phases (Li & Patience, 2017), however, this association is poorly understood in young animals. Some studies support the theory that dietary energy levels modulate voluntary feed intake in piglets (Vieira et al., 2015; Ribeiro et al., 2016).

It is possible that some divergences in responses of piglet to energy of diet are because of variations in characteristics of experimental diets, including the energy levels. For example, it is known that a constant nutrient/energy ratio in diets are important to correctly evaluate the effects of dietary energy levels on animal performance (Quiniou & Noblet, 2012). In this sense, a proper adjustment between the levels of energy and amino acids in a diet is indispensable, especially regarding the performance and behavior of piglets. Knowing whether piglets can adjust feed intake according to the energetic level of the diet is also important to define the optimal energy level using economic criteria, for example. On the other hand, the voluntary feed intake of piglets may be limited by the physical capacity of the intestine and preference should be given to a diet with a high energy level (Quiniou & Noblet, 2012; Kim et al., 2020).

Furthermore, there is an association between the amount of consumed diet and feeding intake behavior variables, such as the number and duration of visits to the feeder (Andretta et al., 2016), but this has not been fully established. Knowing the feeding patterns of pigs helps to clarify performance-related factors, such as feed efficiency, diet digestibility, and protein deposition (Carcò et al., 2018).

The aim of this study was to evaluate the effect of different dietary metabolizable energy levels on the performance and feed intake behavior in weaned piglets, by keeping constant ME and ratio of other dietary components.

Material and Methods

The procedures adopted to conduct this experiment were in accordance with the provisions of Federal Law No. 11,794, of October 08, 2008, and Decree No. 6899, of July 15, 2009, under case n° 8391090720 on the local Ethics Committee at Use of Animals (CEUA) of Universidade Federal de Santa Maria.

Digestibility test

To validate dietary energy levels, only the pre-initial II diet digestibility was determined, because the amounts of ingredients used in other phases diets were similar. We assumed that these represent a relation between the calculated and the determined energy level of other phases.

Twelve 36-day-old male piglets, with 11.5 ± 0.5 kg average body weight (BW), were housed in metabolic cages (0.65 x 0.55 x 0.41m) equipped with apparatuses for collecting feces and urine separately. Animals were assigned to a changeover design, with six replications per treatment. Two evaluation periods of seven days (each with four days for adaptation to the diets and three days for feces collection) were used. Iron oxide (2.0 g.kg^{-1}) was used to determine the beginning and end of the collection period according to the method described by Schirmann et al. (2018). Treatments consisted of four diets with different ME levels (3.30, 3.40, 3.50, and 3.60 Mcal.ME.kg^{-1}) for the pre-initial phase II, maintaining constant the ME and nutrients ratio (Table 1) to meet the recommendations (Rostagno et al., 2017).

The daily amount of feed supply was calculated based on average feed intake during the adaptation period and adjusted based on metabolic body weight of animals (BW0.75) (Sakomura & Rostagno, 2016). Diet was provided moistened at a proportion of 50:50 (50% feed and 50% water), three times a day (08, 11, and 16 h). Leftovers were weighed and subtracted from the amount supplied.

Fecal and diet samples were collected and stored in a freezer (- 18 °C). For the analysis, samples were thawed, homogenized, and 120 g aliquots were taken from each replication per treatment. Dry matter (DM) content was obtained in an oven at 105 °C, and crude protein (CP) content was determined by the Kjeldahl method (Association of Official Analytical Chemists [AOAC], 1995). Gross energy (GE) was determined using an adiabatic calorimetric pump, and digestibility coefficients were determined according to the method described by (Matterson et al., 1965).

Performance test and feed intake behavior

For the performance study, 64 weaned female piglets, 24 days-old, with 7.5 ± 0.8 kg BW, were used tree diet: pre-initial I (1-7 days), pre-initial II (8-21 days), and initial (22-35 days) post weaning (PW). Animals were housed in a nursery facility, under controlled temperature and, 1.0 m² elevated pens equipped with feeders and ball-bite drinkers. This experiment was performed in a completely randomized block design, with four treatments (3.30, 3.40, 3.50, and 3.60 Mcal.kg^{-1} ME levels) and eight replications of two animals per pen. Animals were given food and water *ad libitum* throughout the experimental period (35 days).

Table 1
Composition of experimental diets for pre-initial I (1-7 days), pre-initial II (8 to 21 days), and initial (22 to 35 days) post-weaning phases

	PRE-INITIAL I (1-7 days)				PRE-INITIAL II (8-21 days)				INITIAL (22-35 days)			
(ME levels in Mcal.kg^{-1})	3.30	3.40	3.50	3.60	3.30	3.40	3.50	3.60	3.30	3.40	3.50	3.60
Ingredients (%)												
Corn	9.71	10.00	10.30	10.57	9.71	10.00	10.30	10.58	49.00	49.45	51.00	52.00
Rice residue	22.33	23.00	23.67	24.32	22.33	23.00	23.68	24.35	0.00	0.00	0.00	0.00
Soybean meal	24.27	25.00	25.74	26.47	28.15	29.00	29.86	30.71	29.30	30.20	31.09	32.00
Whey	14.56	15.00	15.44	15.87	7.77	8.00	8.24	8.47	0.00	0.00	0.00	0.00
Starch	14.80	10.00	5.10	0.40	19.74	15.00	10.28	5.69	15.74	12.00	6.72	2.34
Sugar	3.88	4.00	4.15	4.25	3.88	4.00	4.12	4.24	0.00	0.00	0.00	0.00
Blood plasma	4.86	5.00	5.15	5.32	2.43	2.50	2.58	2.65	1.01	1.04	1.07	1.10
Soy oil	0.67	2.90	5.20	7.40	0.90	3.20	5.50	7.70	1.35	3.60	6.30	8.60
L lysine	0.38	0.39	0.40	0.41	0.40	0.41	0.42	0.43	0.00	0.00	0.00	0.00
DL methionine	0.21	0.21	0.22	0.22	0.21	0.21	0.22	0.23	0.54	0.55	0.56	0.58
L threonine	0.09	0.09	0.10	0.10	0.11	0.12	0.12	0.13	0.21	0.22	0.22	0.24
L tryptophan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.18	0.19	0.19
Limestone	0.51	0.52	0.54	0.55	0.48	0.50	0.53	0.55	0.00	0.00	0.00	0.00
Dicalcium phosphate	1.73	1.80	1.85	1.90	1.65	1.75	1.80	1.85	0.00	0.00	0.00	0.00
Salt	0.20	0.20	0.21	0.21	0.49	0.50	0.52	0.53	0.68	0.68	0.70	0.73
Zinc oxide	0.31	0.32	0.33	0.34	0.31	0.32	0.33	0.34	1.28	1.33	1.36	1.40
Palatability agent	0.39	0.40	0.41	0.42	0.39	0.40	0.41	0.43	0.54	0.56	0.59	0.61
Acidifier	0.58	0.60	0.62	0.64	0.51	0.53	0.54	0.55	0.00	0.00	0.00	0.00
Mycotoxin Adsorbent	0.29	0.30	0.31	0.32	0.32	0.30	0.31	0.32	0.00	0.00	0.00	0.00
Micromineral Premix[a]	0.15	0.15	0.16	0.16	0.15	0.15	0.16	0.16	0.09	0.10	0.10	0.11
Vitamin Premix[b]	0.12	0.13	0.13	0.14	0.12	0.13	0.13	0.14	0.09	0.10	0.10	0.11
Calculated Composition												
ME (Mcal.kg^{-1})	3.30	3.40	3.50	3.60	3.30	3.40	3.50	3.60	3.30	3.40	3.50	3.60
Digestible CP (%)	18.91	19.48	20.06	20.64	18.10	18.65	19.20	19.74	17.88	18.34	18.89	19.40
Calcium (%)	0.83	0.86	0.88	0.91	0.75	0.79	0.82	0.85	0.68	0.70	0.72	0.74
Standardized Phosphorus (%)	0.44	0.46	0.47	0.48	0.39	0.41	0.42	0.43	0.32	0.32	0.33	0.34
Sodium (%)	0.35	0.37	0.38	0.39	0.34	0.35	0.36	0.37	0.26	0.27	0.28	0.29
Lysine (%)	1.41	1.46	1.50	1.54	1.31	1.35	1.39	1.43	1.32	1.35	1.39	1.43
Methionine (%)	0.46	0.47	0.49	0.50	0.45	0.46	0.47	0.49	0.45	0.46	0.48	0.50
Methionine+Cystine (%)	0.78	0.80	0.82	0.84	0.72	0.75	0.77	0.79	0.72	0.74	0.76	0.79
Threonine (%)	0.82	0.85	0.88	0.91	0.77	0.79	0.82	0.84	0.78	0.80	0.83	0.85
Tryptophan (%)	0.24	0.25	0.26	0.26	0.22	0.23	0.24	0.25	0.20	0.21	0.22	0.22

Added per kilogram: selenium, 450 mg; iron, 100g; copper, 15 g; zinc, 150g; cobalt, 500mg; manganese, 70 g; and iodine 14,000 mg. Added per kilogram[b], vitamin A, 9,500,00 IU; vitamin D3, 1,400,000 IU; vitamin E, 55,000 mg; vitamin K, 1900 mg; vitamin B1, 950 mg; vitamin B2, 3,300 mg; vitamin B6, 1,400 mg; vitamin B12, 9,500 mg; pantothenic acid, 9,500 mg; niacin, 14 g; folic acid, 700 mg; and biotin, 38 mg.

Average daily feed intake (ADFI) was obtained by subtracting the leftovers collected weekly from feeders from total amount of offered feed. The average daily gain (ADG) was measured weekly, weighing piglets after 12-hour fasting, and calculating the difference between initial BW and the weekly finish BW divided by seven days. Feed intake and weight gain were expressed as grams per day. Feed conversion ratio (FCR) was calculated by dividing ADFI by ADG. The values obtained for metabolizable energy intake (MEI, Mcal.kg.d^{-1}) were expressed concerning the average body weight (BW, kg.d^{-1}) (Ndou et al., 2013).

Eight animals of each treatment were monitored with cameras, to evaluate feed intake behavior in the pre-initial I and pre-initial II phases; the analyzed variables were the number of individual visits to the feeders (NVF) and duration of visits to the feeder (DVF) in seconds. The analysis consisted of 10 daily observations, eight minutes each, between 6 and 18 h by a single observer (Weiler et al., 2013).

Statistical analysis

The digestibility test data were tested by analysis of variance (ANOVA) using a cross-over experimental design with piglets as covariable.When differences were detected (P <0.05), treatment means were compared by Tukey's test (using 5% significance level). Animal performance and feed intake behavior data were ananalised by a ANOVA using completely randomized block design. Subsequently, regression procedures were used to fit models explaining the behavior of variables as a function of dietary ME levels.

Results and Discussion

Diet digestibility

In the digestibility test, it was considered a basis pre-initial II diet data because support a similar assumption regarding the calculated energy values in pre-initial and initial diets. Dry matter digestibility coefficient (DMDC) and gross energy digestibility coefficient (GEDC) showed no difference in ME levels (P> 0.05), with an average digestibility of 87.8% and 88.8%, respectively (Table 2). Digestibility coefficient (DC) and energy values of the pre-initial II diets, which were supplied between days 8 and 21 after weaning, were experimentally determined to verify if their energy levels were similar to those calculated. Higher ME levels on the diet affected the crude protein digestibility coefficient (CPDC) (P <0.05) Yu et al. (2017) and Adebowale et al. (2019) observed similar results, explained by a decrease in the amino acids blood serum levels, indicating that increasing the diet energy density may reduce protein digestibility and affect amino acid absorption.

Performance

The hypothesis of this study is that weaned piglets, similarly to growing and finishing pigs, regulate feed intake within certain limits to meet energy requirements. This implies that, if necessary, the energy level in diets for piglets can be manipulated with no influence on animal performance if nutrient/energy ratio is maintained constant. In the first 7 days after weaning (pre-initial phase I), ME level had no effect (P >0.05) on performance (Table 3). The fact that DFI was not influenced by dietary ME levels in the first week of the experiment (pre-initial I) may have been due to the variability in feed intake data (Kim et al., 2020). In the first days after weaning, piglets go through a delicate period, in which their physiological and immunological aspects are affected (Li & Patience, 2017). Each animal reacts uniquely to this situation, which increases variability in performance responses during this period.

Table 2
Digestibility coefficients of pre-initial II phase (8-21 days post-weaning)

	Metabolizable Energy Level (Mcal.kg^{-1})					
	3.30	3.40	3.50	3.60	SEM	*p*-value
Piglets, n	6	6	6	6		
DMDC (%)	88.5	88.5	87.2	86.9	0.51	0.093
CPDC (%)	90.0^{a}	89.9^{ab}	89.1^{ab}	88.8^{b}	0.11	0.022
GEDC (%)	88.9	89.0	88.7	88.6	0.03	0.110
DE (Mcal.kg^{-1})	3.42^{d}	3.52^{c}	3.65^{b}	3.73^{a}	0.02	<0.001
ME* (Mcal.kg^{-1})	3.29^{d}	3.38^{c}	3.49^{b}	3.58^{a}	0.02	<0.001

DMDC = dry matter digestibility coefficient, CPDC = crude protein digestibility coefficient,
GEDC = gross energy digestibility coefficient, DE = digestible energy, ME = metabolizable energy.
^{a,b,c,d} Means, on the same line, followed by different letters, differ by Tukey's test (5%).
*Calculated according to methodology Matterson et al. (1965).

The increase in ME level in the pre-initial II diet (8 to 21 days PW) caused a quadratic decrease in ADFI (1.325 x ME2 - 9.3855 x ME + 17.353, g.d^{-1}, r² = 0.99), but did not influence ADG (P>0.05), with an average of 560 g.d^{-1}. Resulting in FCR reduced linearly (-0.4 + 2.735 x ME, g.g^{-1}, r² =0.98) due to ME levels, while ingested ME (IME) per kg BW did not differ between treatments (P >0.05), with an average of 187 kcal.kg.BW^{-1}. Based on this information we can assume, piglets could regulate energy intake to meet a determined demand, regardless of the ME content of the evaluated diets (Schneider et al., 2010). The absence of differences in IME, not only corroborated the previous proposition, but also explained the quadratic effect of ADFI as a function of dietary ME levels reduction. This is because the intake of ME was similar between treatments, ranging from 0.185 to 0.190 Mcal.kg^{-1}. Applying the model cited by the NRC (2012), of energy partitioning to experimental data, were obtained a ME requirement of 200 Mcal.kg^{-1}, which is slightly higher than those found in this study.

Table 3
Performance of piglets subjected to different levels of metabolizable energy in the pre-initial I (1-7 days), pre-initial II (8-21 days), and initial (22-35 days) post-weaning phases

	Metabolizable Energy Level (Mcal.kg^{-1})				SEM	*p*-value
	3.30	3.40	3.50	3.60		
Piglets, n	16	16	16	16		
Pre-initial I (1-7 days)						
Initial BW, kg	7.49	7.39	7.41	7.37	0.01	0.998
Final B, kg	10.20	10.10	9.88	10.03	0.03	0.963
ADG, g.d^{-1}	387	387	353	380	25.3	0.751
ADFI, g.d^{-1}	458	445	422	432	0.01	0.621
FCR, g.g^{-1}	1.18	1.15	1.19	1.13	0.02	0.294
IME(Mcal.kg.d^{-1})	0.171	0.173	0.170	0.176	6.27	0.940
Pre-initial II (8-21 days)						
Initial BW, kg	10.20	10.10	9.88	10.03	0.03	0.963
Final B, kg	18.23	17.83	17.52	18.00	0.53	0.805
ADG, g.d^{-1}	573	552	546	569	13.7	0.401
2ADFI, g.d^{-1}	810	761	734	738	0.01	0.002
1FCR, g.g^{-1}	1.41	1.38	1.34	1.29	0.00	<0.001
IME (Mcal.kg.d^{-1})	0.190	0.186	0.185	0.189	2.42	0.427
Initial (22-35 days)						
Initial BW, kg	18.23	17.83	17.52	18.00	0.53	0.805
Final B, kg	27.63	27.35	27.11	27.22	0.05	0.874
ADG, g.d^{-1}	672	680	685	666	18.0	0.850
1ADFI, g.d^{-1}	1113	1061	1035	990	0.02	0.036
2FCR, g.g^{-1}	1.66	1.56	1.52	1.49	0.01	<0.001
IME (Mcal.kg.d^{-1})	0.160	0.160	0.162	0.157	3.80	0.785

BW = body weight, ADG = Average daily gain, ADFI = Average daily feed intake, FCR = feed conversion ratio, IME (Mcal.kg.d^{-1}) = metabolizable energy intake (kg) expressed concerning the average body weight (BW); ^{1}Linear effect; ^{2}Quadratic effect.

In the initial phase (22-35 days after weaning), dietary ME levels had no effect (P >0.05) on ADG, which averaged 675 g.d^{-1}, and in IME with a daily calculated average of 0.160 Mcal.kg^{-1} BW. However, ADFI decreased linearly (- 0.395 x ME + 2.4125, g.d^{-1}, r^2 0.99) with increasing ME levels. This means that increase in dietary energy levels reduce diet intake, but without any effect on BW gain (Vieira et al., 2015). Conversely, other studies in the literature have shown that increases in dietary ME intensify BW gain in weaned piglets (Quiniou & Noblet, 2012; Silva et al., 2020). Differences found in these studies, are likely related to variations in the composition of dietary ingredients and manipulation of nutrient densities.

FCR showed a quadratic response (1.8385 x ME2 - 13.247 x ME + 25.349, $g.g^{-1}$, r^2= 0.99) to treatments. As this variable expresses the relationship between consumption unit per weight gain unit, were already expected this is results. Such findings indicate that high-energy diets are beneficial to piglets. However, a detailed economic analysis, which is beyond the scope of this study, should be conducted to determine the best cost-benefit ratio regarding the ideal dietary energy level. The expectation was that higher ME levels result in lower ADFI and FCR, which was detected in the initial phase (22 to 35 days after weaning). The lack of differences in weight gain or IME between treatments demonstrates that piglets could adapt to the energy levels in diets (Fang et al., 2019).

Feed intake behavior

The number of individual visits to the feeder (NVF) in the first 7 days after weaning (Table 4) had a linear effect with increasing ME levels (- 0.021 x ME + 81.7, r^2 = 0.98), the same was observed for the duration of visits to the feeder in seconds (-1.491 x ME + 5848.7, r^2 = 0.98). In the pre-initial phase II, dietary ME levels influenced linearly NVF (0.011 x ME + 51.2, r^2 = 0.89) and DVF in seconds (-0.742 x ME + 3155.9, r^2=0.98). These findings on the effect of dietary ME levels on feed intake behavior corroborate those of Noblet and van Milgen (2013), who evaluated growing pigs, and suggested that pigs tend to make a greater or lesser number of visits to the feeder as a function of diet energy density.

Bruininx et al. (2001) analyzed the behavior of weaned piglets housed individually and fed a 3.0 $Mcal.ME.kg^{-1}$ diet, and observed an average number of visits to the feeder of 12.5 day^{-1}. This value support with this result found in this study, for the same evaluation period (1-7 days), at ME levels of 3.30 and 3.40 $Mcal.ME.kg^{-1}$. Based on this information, weaned piglets modulated their feeding behavior as a function of dietary ME levels. However, studies aimed at clarifying how ME influences the feed intake behavior of weaned piglets are scarce. Being necessary, more research to evaluate this variable that is directly linked to animal performance.

Table 4
Feed intake behavior of piglets submitted to different pre-initial metabolic energy levels (1-7 days), and pre-initial (8-21 days) post-weaning

	Metabolizable Energy Level ($Mcal.kg^{-1}$)					
	3.30	3.40	3.50	3.60	SEM	*p*-value
Piglets, n	8	8	8	8		
	Pre-initial I (1-7 days)					
NVF [1]	12	11	8	6	0.65	<0.001
DVF, s[1]	982	757	500	456	113	0.008
	Pre-initial II (8-21 days)					
NVF [1]	15	14	12	12	0.64	0.001
DVF, s[1]	711	636	542	495	60	0.009

NVF = number of individual visits to the feeder; DVF = duration of visits to the feeder in seconds; [1]Linear Effect.

Conclusion

Weaned piglets can regulate the feed intake according to dietary metabolizable energy levels, except in the first week after weaning. The performance of weaned piglets can be maintained using diets containing metabolizable energy levels between 3.30 at 3.60 Mcal.ME.kg^{-1} if the ratio of nutrients to energy is maintained constant. The feed intake behavior of weaned piglets is influenced by increases in dietary metabolizable energy levels evaluated, resulting in fewer and shorter visits to the feeder.

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