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Evaluation of different feed flavours on the performance of piglets during nursery and its impacts on late finishing performance and carcass traits

Avaliação de diferentes aditivos sensoriais no desempenho de leitões durante a fase de creche e impactos no desempenho final e características de carcaça

Evaluación del uso de diferentes aromatizantes en el pienso de los lechones durante la transición sobre su rendimiento y su impacto sobre el rendimiento al final del cebo y los parámetros de la canal

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Abstract
Weaning is a critical time for the young pig. The nutrient requirements of nursery pigs are affected by many factors such as weaning age, antigen exposure, and sex of the pig. Also, since feed intake is influenced by the learning abilities of the animal, any negative post-ingestive experiences with digestion may be linked to the feed and decrease feed intake. The present study aimed to evaluate the impact of the supplementation of different feed flavours for

piglets during nursery phase on their performance and analyze the correlation between nursery performance and grower/ finisher performance and carcass traits. The use of flavored feed in nursery pens had a positive effect on voluntary feed intake and consequently overall nursery phase performance, which also impacted positively on piglet growth rates. Our results also indicated that there is a direct impact of the nursery end BW and finisher performance traits. Pigs that ate more gained more weight and were heavier at the end of nursery, also grew faster and were heavier at slaughter than the control pigs. This higher BW at slaughter also reflected on improved carcass performance traits. We can conclude that the use of feed flavours is an important tool to reduce post-weaning stress and enhance piglet performance during nursery which impacts positively on finisher output performance and carcass traits.
Keywords: Pigs; Palatibility; Feed intake; Meat percentage.

Resumo
O desmame é um momento crítico para leitões jovens. A exigência nutricional de leitões na fase de creche pode ser afetada por diversos fatores, dentre eles idade de desmame, exposição a antígenos e sexo. O consumo voluntário também é influenciado pelas habilidades aprendidas do animal, de modo que qualquer experiência negativa relativa à ingestão e digestão, pode ser relacionada ao alimento e diminuir o consumo voluntário. Com presente estudo tem-se o objetivo de avaliar os impactos da suplementação de diferentes aditivos sensoriais para leitões na fase de creche sobre o desempenho e a correlação entre o desempenho na creche e em crescimento e terminação e as características de carcaça. O uso de aditivos sensoriais em baias de creche tem mostrado efeito positivo sobre o consumo voluntário e consequentemente no desempenho geral na fase de creche, o que impacta positivamente na taxa de crescimento dos leitões. Nossos resultados indicaram que existe impacto direto entre a fase final de creche e o peso corporal nas fases finais. Leitões que comeram mais, ganharam mais peso e estiveram com maior peso ao final da fase de creche, também cresceram mais rápido e foram abatidos mais pesados em comparação ao grupo controle. O maior peso corporal até o abate refletiu em melhores características de carcaça. Nós podemos concluir que o uso de aditivos sensoriais é uma importante ferramenta para reduzir o estresse pós desmame e melhorar o desempenho de leitões durante a fase de creche, o qual impacta positivamente nas fases finais do processo de produção de suínos e nas características de carcaça.
Palavras-chave: Suínos; Palatibilidade; Consumo de ração; Porcentagem de carne.

Resumen
El destete es un momento crítico para el lechón. Sus necesidades nutricionales durante la transición se ven afectadas por muchos factores, como la edad de destete, la exposición a antígenos y el sexo. Además, dado que la ingesta de alimento está determinada por la capacidad de aprendizaje del animal, cualquier experiencia negativa con la digestión después del destete puede estar relacionada con el pienso y disminuir su ingesta. El presente estudio tuvo como objetivo evaluar el impacto de la suplementación de diferentes aromatizantes en el pienso de los lechones durante la transición sobre su rendimiento, y analizar la correlación entre este y el obtenido al final del cebo y los parámetros de la canal. El uso de piensos con aromatizantes en los corrales de transición tuvo un efecto positivo en la ingesta voluntaria de pienso y, en consecuencia, sobre el rendimiento global de la fase de transición, lo que también repercutió positivamente en las tasas de crecimiento de los lechones. Nuestros resultados también indicaron que existe un impacto directo entre el peso vivo final en la fase de transición y los parámetros de rendimiento al final del cebo. Los cerdos que comieron más ganaron más peso y fueron más pesados al final de la transición, también crecieron más rápido y fueron más pesados al sacrificio que los cerdos de control. Este mayor peso vivo al sacrificio también se reflejó en la mejora de los parámetros de rendimiento de la canal. Podemos concluir, que el uso de aromatizantes en el pienso es una herramienta importante para reducir el estrés post-destete y mejorar el rendimiento de los lechones durante la transición, lo que repercute positivamente en el rendimiento zootécnico de los animales al final del cebo y en el de los parámetros de la canal.
Palabras clave: Cerdos; Palatibilidad; Ingesta de alimento; Porcentaje de carne.

1. Introduction

Weaning is a critical time for the young pig. It is a time when the digestive tract must adjust to a change from a liquid diet to a solid diet which is accompanied by a change in carbohydrate source, fat level, and many other dietary alterations (Trindade Neto et al., 2003). The nutrient requirements of nursery pigs are affected by many factors such as weaning age, antigen exposure, and sex of the pig. Also, since feed intake is influenced by the learning abilities of the animal, any negative post-ingestive experiences with digestion may be linked to the feed and decrease feed intake. When nursery diets are formulated, a primary objective is selecting ingredients that will stimulate feed intake and maximize performance. Moreover, Zhu et al. (2016) found that the increased feed intake associated with increased diet complexity was most pronounced in the immediate post-weaning period and decreased thereafter. Several authors have described the possible benefits of improving piglet performance during nursery and correlating this with carry-on effects during grower and finisher phases, improving performance and carcass traits (Sterk et al., 2008; Sulabo et al., 2010; Taveira, 2017).Therefore, the present study aimed to evaluate the impact of the supplementation of different feed flavours for piglets during nursery phase on their performance and analyze the correlation between nursery performance and grower/ finisher performance and carcass traits.

2. Methodology

All methods involving animal handling were realized in accordance with the regulations approved by the Institutional Animal Welfare and Ethics/Protection committee from the Universidade Federal de Minas Gerais (UFMG – CEUA), Brazil; protocol 019/18. The study was performed between September 2018 and March 2019; and was conducted in the facilities of Instituto Federal Norte de Minas Gerais swine production laboratory in a region characterized climatically as tropical climate (Aw class according Koppen 1948).

A total of 120 piglets (60 castrated males and 60 females) belonging to the same commercial genetic line (TP20 x TRAXX) were used. Piglets were housed in groups of five animals per pen according to body weight, litter origin and sex. The trial consisted of four dietary treatments and six replications per treatment. The dietary treatments consisted of feeding the animals with: a standard control diet + sugar (CN – 350 g/100 kg); a standard diet with Powersweet® (PS – 30 g/ 100 kg); a standard diet with a modified a feed flavour Delistart_M® (DEM – 50 g/100 kg); and a standard diet with Delistart® (DEL – 50 g/100 kg). Powersweet® is proprietary mixture of sodium saccharin, thaumatin and Neohesperidin Dihydrochalcone (NHDC) high intensity sweeteners. Delistart® formulas are proprietary mixtures of sodium saccharin, thaumatin and NHDC high intensity sweeteners, at the same ratio as Powersweet®, combined with chemically defined aldehydes, ketones and esters to impart sweet fruit type flavours.

Diets were formulated according to the growing stage of the animals: Phase 1 diet, from 24 to 36 days; Phase 2 diet, from 37 to 49 days; Phase 3 diet, from 50 to 56 days; and Phase 4 diet, from 57 to 63 days. All diets were formulated to meet or exceed the nutritional requirements for piglets according to the recommendations of Rostagno et al. (2017). Samples of each formulated diet were taken for DM determination and chemical analysis of dietary composition at the feed mill. Every morning, feed refusals were collected when available, and fresh feed was immediately distributed once per day between 06:30 and 07:30. Feed consumption was determined as the difference between feed allowance and the refusals collected on the next morning. Thereafter, the samples were pooled per phase, and then DM content was measured. Samples of the fresh feed were also taken every day and similarly pooled for DM determination and chemical analysis of dietary composition and phase. The variations in ambient temperature, RH, and photoperiod followed closely the outdoor conditions. Ambient temperature and RH were continuously recorded (1 measurement every 5 minutes) in the barns, using a datalogger connected to a probe (Didai Tecnologia Ltda., Campinas, Brazil) placed 1 m above the floor.

Piglets were individually weighed at the beginning and at the end of each phase of the experiment. For each growing stage, average daily gain of each pig and average daily feed intake and gain: feed ratio per pig in a pen was calculated. At d 63 of nursery, the exact same groups of piglets were transferred to individual pens in the grower/finisher facilities. Animals were housed following the same group setup from nursery phase. During these stages pigs were fed a multiphase standard feeding program: from 63 – 77 d the previous treatments used during nursery (adaptation); 78 – 84 days Grower 1; 85 – 104 days Grower 2; 105 – 140 days Finisher 1; and 141 – 154 days Finisher 2. All pigs were weighed at the end of each phase (84; 104; 140 and at 154 d of age). Pigs were fed ad libitum via semi-automatic feeders (15 kg capacity) and had free access to water via drinking nipples. At day 154 of age, one pig from each pen (closest to the average pen weight) was slaughtered and all carcass traits were analysed (carcass yield, meat, fat percentage and content, cut yield, longissimus dorsi and loin area). The calculations for lean meat yield and percentage were used by the USDA method whereas, Quantity of lean meat (lb) = 8.588 +

(0.465 x hot carcass weight (lb)) + (3.005 x loin area (in)) – (21.896 x BF (in)). Muscularity or USDA muscle score, was calculated as the muscle depth in relation to the whole skeleton dimension, carcass fat and muscle content (Deboer et al., 1974).

The effects of diet treatments, blocks and initial weight will be tested according to a general linear procedure analysis of variance (GLM procedure of SAS). The initial weight of the piglets will be considered as a covariate in the model. The least square means procedure (PDIFF option) will be used to compare means when a significant F-value is obtained. Means comparison will be performed according to the Pdiff option of SAS procedure using Student-Newman-Keuls test for contrasts.

3. Results

Average minimum and maximum temperatures and relative humidity levels measured during the experimental nursery period were 28.0 and 20.3 ˚C, and 72.3 and 60%, respectively. Average minimum and maximum temperatures and relative humidity levels measured during the experimental grower/finisher period were 34.1 and 24.2 ˚C, and 83.3 and 62%, respectively.

Nursey phase

At weaning the piglets were on average 24 days old. Piglet and litter weight at start were not influenced (P>0.10) by the treatments (7.33 kg on average, respectively; Table 1). During the first week, treatments did not influence feed intake (P=0.866) nor end weight (P=0.553). Although there was no significant difference, still piglets fed diets with DEL and PS showed higher numerical feed intake when compared to other treatments (2.150 and 2.247 kg vs. 2.065 kg on average CN/DEM; Table 1). Feed conversion ratio was not influenced (P=0.173) by the treatments at this stage. Nevertheless, piglets fed DEM showed the lowest numerical FC when compared to the other treatments (1.310 vs.1.610 vs.1.643 vs. 1.749; respectively for DEM and CN and DEL and PS).

During second week, treatments did not influence feed intake (P=0.803) nor end weight (P=0.588). Nevertheless, still piglets fed diets with PS and CN showed higher feed intake when compared to other treatments (4.087vs. 3.951 kg vs. 3.831vs. 3.828 kg; respectively for PS and CN and DEM and PS; Table 1). Feed conversion ratio was not influenced (P=0.1977) by the treatments. Still, piglets fed DEL showed the lowest FC when compared to the other treatments (1.510 vs.1.907 vs.1.801 vs. 1.700; respectively for DEL and CN and PS and DEM). Treatments did not influence BW gain (P=0.441) during this period, still DEL piglets showed higher numerical gain when compared to the other treatments (2.53 vs. 2.072 vs. 2.269 vs. 2.254 kg; respectively for DEL and CN and PS and DEM).

During the third week, treatments influenced voluntary feed intake (P=0.044) and BW gain (P=0.025). Whereas piglets fed diets with DEL showed higher feed intake when compared to other treatments (5.711 vs. 5.027 kg vs. 5.137 vs. 5.257 kg; respectively for DEL and CN and PS and DEM; Table 1). Piglets fed DEM and PS showed higher BW gain during the growth stage (4.200 vs. 4.146 vs. 3.648 vs. 3.786 kg; respectively for DEM and PS and CN and DEL). Feed conversion ratio was also influenced (P=0.001) by the treatments. Whereas piglets fed DEL showed the highest FC when compared to the other treatments (1.509 vs. 1.378 vs. 1.239 and 1.252; respectively for DEL, CN, PS and DEM).

During the fourth week treatments did not influence feed intake (P=0.987) nor end weight (P=0.256). As for the fifth week, treatments influenced voluntary feed intake (P=0.016) and BW gain (P=0.004). Whereas piglets fed diets with DEL showed higher feed intake when compared to other treatments (8.913 vs. 7.919 kg vs. 8.244 vs. 8.621 kg; respectively for DEL and CN and PS and DEM; Table 1). Piglets fed PS showed higher BW gain during this growth stage (5.811 vs. 4.995 vs. 5.014 vs. 5.247 kg; respectively for DEL, CN, PS and DEM). Feed conversion ratio was not influenced (P=0.827) by the treatments.

During the sixth week, treatments influenced voluntary feed intake (P=0.041) and BW gain (P=0.006). Whereas piglets fed diets with DEL showed higher feed intake when compared to other treatments (8.835 vs. 7.813 kg vs. 8.048 vs. 8.495 kg; respectively for DEL and CN, PS and DEM; Table 1). Piglets fed DEL showed higher BW gain during the growth stage (6.791 vs. 4.947 vs. 5.200 vs. 5.005 kg; respectively for DEL and CN, PS and DEM). Feed conversion ratio was also influenced (P=0.001) by the treatments. Whereas piglets fed DEL showed the lowest FC when compared to the other treatments (1.301 vs. 1.579 vs. 1.548 and 1.697; respectively for DEL, CN, PS and DEM). Treatments influenced (P=0.026) statically overall total feed intake, where piglets fed DEL presented a higher total feed intake when compared to the other treatments (37.139 vs. 34.472 vs. 35.284 vs. 35.878 kg; respectively for DEL, CN, PS and DEM) which tended to reflect in a higher total BW gain (25.144 vs. 21.997 vs. 22.282 vs. 23.347 kg; respectively for DEL, CN, PS and DEM; P=0.053), and a reduced feed conversion (P=0.068) when compared to the average of the other treatments (1.477 vs. 1.567 vs. 1.584 vs. 1.537 kg; respectively for DEL, CN, PS and DEM), Treatments did not influence piglets fecal scoring (on average 3.22; P=0,748; Table 1).

Grower/ finishing phase

During first grower stage, nursery treatments influenced feed intake (P=0.034), BW gain (P=0.019) and FC (P=0.045). Whereas pigs fed diets with PS, DEM and DEL during nursery showed a higher feed intake when compared to control (91.15 vs. 93.32 vs. 88.19 vs. 82.74 kg; respectively for PS, DEM, DEL and CN; Table 2). As a consequence of a higher feed intake, BW gain was also higher for these same treatments (32.84 vs. 33.99 vs. 33.1 vs. 30.18 kg; respectively for PS, DEM, DEL and CN; Table 2). Feed conversion ratio was lower for the DEL pigs when compared to the other treatments (2.503 vs. 2.741 vs. 2.775 vs. 2.746; respectively for DEL, CN, PS and DEM; Table 2). During the final grower stage, pigs from CN showed a higher feed intake (146.8 vs. 141.98 vs. 134.59 vs. 141.64 kg; respectively for CN, PS, DEM and DEL; P=0.025), and higher FC (3.067 vs. 2.820 vs. 2.588 vs. 2.894 kg; respectively for CN, PS, DEM and DEL; P=0.002). Overall FC was influenced by treatments whereas CN showed the highest value and DEM the lowest value (2.941 vs. 2.803 vs. 2.651 vs. 2.803 kg; respectively for CN, PS, DEM and DEL; P=0.001).

Carcass traits

Nursery treatments influenced carcass traits in pigs at slaughter. Pigs from the CN treatment showed a shorter carcass length when compared to the other treatments (P=0.001; Table 3). Pigs from the PS and DEM showed a higher loin area (P=0.043; Table 3) when compared to CN and DEL (59.10 and 61.75 vs. 55.15 vs. 54.21 cm2; respectively for PS, DEM, DEL and CN). The best carcass yield came from the pigs' fed PS and DEM during nursery followed by DEL and CN (80.77 and 80.73 vs. 79.74 vs. 79.02%; respectively for PS, DEM, DEL and CN).

Table 1- Evaluation of different Feed Flavours on the performance of piglets during nursery (24 – 68 d) (Least square means) *.

Parameters	Sugar (CN)	PowerSweet® (PS)	Delistart® Modifed (DEM)	Delistart® (DEL)	P value	Variation coeficient
Av. BW at start 24 d, kg	7.320	7.327	7.327	7.340	-	-
Av. BW at 31 d, kg	8.598	8.636	8.909	8.624	0.553	4.83
Av. BW gain period, kg	1.278	1.309	1.582	1.284	0.553	30.79
Total feed intake period, kg	2.057	2.150	2.073	2.247	0.866	20.25
Feedconversion	1.610	1.643	1.310	1.749	0.173	21.76
Av. BW at 38 d. kg	10.670	10.904	11.163	11.160	0.588	6.71
Av. BW gain period. kg	2.072	2.269	2.254	2.536	0.441	22.97
Total feed intake period. kg	3.951	4.087	3.831	3.828	0.803	13.01
Feedconversion	1.907	1.801	1.700	1.510	19.77	0.853
Av. BW at 45 d, kg	14.455	15.051	15.363	14.808	0.499	5.44
Av. BW gain period, kg	3.648b	4.146ab	4.200a	3.786ab	0.025	7.17
Total feed intake period, kg	5.027b	5.137ab	5.257ab	5.711a	0.044	7.78
Feedconversion	1.378b	1.239b	1.252b	1.509a	0.001	9.72
Av. BW at 52 d, kg	19.375	19.394	20.422	19.882	0.256	4.64
Av. BW gain period, kg	4.920	4.344	5.059	5.074	0.142	12.05
Total feed intake period, kg	7.705	7.618	7.601	7.606	0.987	6.89
Feedconversion	1.566	1.754	1.503	1.499	0.674	11.56
Av. BW at 59 d, kg	24.370	24.408	25.669	25.693	0.426	3.38
Av. BW gain period, kg	4.995b	5.014b	5.247b	5.811a	0.004	7.03
Total feed intake period. kg	7.919b	8.244ab	8.621ab	8.913a	0.016	6.00
Feedconversion	1.585	1.644	1.643	1.534	0.827	10.95
Av. BW at 66 d, kg	29.317	29.608	30.674	32.484	0.051	3.99
Av. BW gain period, kg	4.947b	5.200b	5.005b	6.791a	0.006	16.45
Total feed intake period, kg	7.813	8.048	8.495	8.835	0.041	9.66
Feedconversion	1.579a	1.548a	1.697a	1.301b	0.001	9.25
***Total Nursery Performance*:**						
Av. BW gain, kg	21.997	22.282	23.347	25.144	0.053	5.25
Total feed intake period, kg	34.472	35.284	35.878	37.139	0.265	4.79
Feedconversion	1.567	1.584	1.537	1.477	0.685	4.73
Fecal score**	3.228	3.226	3.225	3.224	0,748	17,07

*Values followed by different letters in the same row are statistically significant via Student-Newman-Keuls at a level of $P<0,05$. **The incidence and severity of diarrhea was observed by a visual inspection of the consistency of fecal material on a scale of 1–5: whereas, 1. no diarrhea hard and dry consistency; 2. no diarrhea soft and humid consistency considered as normal; 3. no diarrhea soft. humid and pasty consistency; 4. pasty diarrhea; and 5. liquid diarrhea. Source: Authors (2020).

4. Discussion

Nursey phase

Weaning is one of the most stressful times in the pig production cycle, and is associated with adverse effects during this stage: the separation from the mother, a change of environment, the mixing with animals from different litters and the change of the diet, among other factors. All these produce a negative stress in the piglet and a neophobia to the feed that results in a low feed intake at the weaning (Da Silva et al., 2020). Post-weaning diarrhea is a common problem, due to the fact that the gastrointestinal tract is still under maturation process (Quadros et al., 2002). Diarrhea can reduce weight gain and, in some cases, damages the gastrointestinal villi. All of these changes during the transition phase in the early life of the piglet can have a negative impact on performance during the nursery and later growing stages (Boudry et al. 2004). Therefore, to help the animals through this stressful period, nutritional support and care are essential. According to Roura and Tedó (2009), the imprinted preference for certain flavoring compounds is long lasting in piglets, therefore, using sensory strategies could allow to create a preferential effect through the tastes and flavors of the diet.

Table 2- Evaluation of different Feed Flavours during nursery (24 – 63 d) on the performance traits during grower/ finisher phase (68 – 154 d) (Least square means) *.

Parameters	Sugar (CN)	Powersweet® (PS)	Delistart® Modifed (DEM)	Delistart® (DEL)	P value	Variation coeficient
Initial BW, kg	29.317	29.608	30.674	32.484	-	-
BW at 110 d, kg	59.502	62.452	64.664	65.548	0.210	3.32
BW gain, kg	30.185b	32.844a	33.990a	33.064a	0.019	4.97
Total Feedintake, kg	82.746b	91.150ab	93.326a	88.197ab	0.034	6.59
Feedconversion	2.741ab	2.775a	2.746ab	2.503b	0.045	4.71
BW at 154 d, kg	107.357	112.797	116.665	114.488	0.481	4.11
BW gain, kg	47.854	50.344	52.001	48.941	0.395	8.63
Total Feedintake, kg	146.793a	141.984ab	134.596ab	141.639b	0.025	5.31
Feedconversion	3.067a	2.820a	2.588b	2.894a	0.002	8.23
***Performance* total: 66 to 154 d**						
BW gain, kg	78.039	83.188	85.991	82.005	0.165	4.878
Total Feedintake, kg	229.539	233.134	227.922	229.836	0.111	3.526
Feedconversion	2.941a	2.803b	2.651c	2.803b	0.001	3.930

*Values followed by different letters in the same row are statistically significant via Student-Newman-Keuls at a level of P<0,05. Source: Authors (2020).

Pigs show have a sensitive olfactory system, which is able to recognize several non-volatile compounds, the sweet taste being the most acceptable. According to Jones et al. (2000), five odourised foods which are categorized by humans as sweet (i.e., almond oil, peach, raspberry, vanilla and strawberry) have a good acceptance by pigs. These same authors stated that pigs have an innate preference for vanilla and raspberry flavors with a positive influence on feed intake. The findings presented by the previous authors are also consistent with the pig preference values for sweeteners observed by Glaser et al. (2000). Therefore, we can infer that in our study, the use of different sweet-tasting flavor agents added to the diets stimulated the oronasal sensing mechanisms and improved piglet feeding behavior, increasing voluntary feed intake throughout the nursery phase. Similar to our findings, Martinez et al. (2014), also observed that sweeteners can influence the piglets' performance during nursery phase. The use of DEL improved voluntary feed intake (+5%) which reflected in a higher total BW gain (+11%) and a reduced feed conversion (-8%) when compared to the average of the other treatments. Several authors have reported similar findings like these (Morrow-Tesch, 1990; Lei et al., 2017; Paula, 2018; Lee et al., 2018). These results prove the efficiency of sweeteners and flavours in improving voluntary feed intake and consequently the performance of piglets after weaning (Costa et al. 2003; Budiño et al., 2014; Clouard et al., 2014).

Grower/ finishing phase and Carcass traits

So far, no work has evaluated the benefits of using sweeteners in post-weaning diets to stimulate voluntary feed intake and correlate the findings with the growth and finishing phases. During first grower stage, pigs fed with the feed flavors showed an improved feed intake (+9.8%) and BW gain (+10%). As during the second grower stage, pigs from CN showed a higher feed intake (+5%), but a lower BW gain (-2.57 kg) and higher FC (+9.8%). We can assume that the CN pigs showed a compensatory feed intake to compensate for the lower feed intake and growth rate from the previous phases. These findings indicate that although there can be a compensatory feed intake in pigs, this still does not reflect in an improvement of growth rate and efficiency at slaughter. Which means that if pigs are limited at early growth stages, they are not capable of producing at the same level as of pigs that are not limited at later growth stages. Our findings could indicate a genetic reprogramming due to nutrient deficiency intake at a certain growth stage. According to Wolter and Ellis (2001), pigs that have a lower growth rate during the nursery phase, consequently require significantly more days to reach market weight.

Table 3- Evaluation of different Feed Flavours during nursery (24 – 63 d) on carcass traits of pigs at slaughter (Least square means) *.

Parameters	Sugar (CN)	Power Sweet® (PS)	Delistart® Modifed (DEM)	Delistart® (DEL)	P value	Variation coeficient
Warm carcass (kg)†	90.683	96.237	99.337	91.310	0.240	8.66
Carcass length (cm)	84.994b	87.999a	90.332a	88.342a	0.001	1.94
Carcass yield (%)	79.026	80.775	80.733	79.743	-	-
Fat depth (first rib -mm)	36.003	30.683	28.670	26.977	0.269	26.30
Fat depth (last rib -mm)	19.671	15.022	17.671	16.635	0.770	45.06
Fat depth (loin -mm)	21.336	20.680	19.669	18.981	0.959	40.08
Loin depth (mm)	51.167	57.501	55.167	51.498	0.197	10.56
Loin weight (kg)	2.553	2.717	2.750	2.506	0.464	11.80
Ham weight (kg)	9.954	10.614	10.464	10.042	0.172	5.61
Shoulder weight (kg)	6.591	6.454	6.530	6.272	0.658	7.06
Loin area (cm²)	54.21b	59.10a	61.75a	55.15b	0.043	8.21
Total carcass meat (kg)	50.756	51.696	54.179	50.643	0.314	6.91
Total carcass lean meat (kg)	52.40	452.675	56.227	51.500	0.068	5.73
Lean meat yield (%) (USDA)	55.15	58.16	57.07	56.37	-	-
Carcass meat percentage (%)	53.71	57.04	55.27	55.50	-	-
Muscle score (USDA grade) #	2.60	1.70	1.78	1.79	0.722	75.68

*Values followed by different letters in the same row are statistically significant via Student-Newman-Keuls at a level of P<0,05. † With head, feet and tale. # Carcass estimation method (USDA): 1= minimum of 68,4%; 2= between 65,4 and 68,3; 3= between 62,4 and 65,3; and 4=62,3. Source: Authors (2020).

Mahan (1995) reported that large variation in weight in groups of pigs normally occurs at weaning. Lighter weight pigs have lower feed intakes and reduced weight gains than those of a heavier weight (Himmelberg et al. 1985; Mahan et al. 1998). The higher BW at slaughter from the flavour fed pigs during nursery, also reflected on higher carcass performance traits. Our findings indicated that although there can be a compensatory feed intake in pigs that experienced a lower feed intake and developed less during nursery and early growing stages, this still does not reflect in an improvement of growth rate and deposition efficiency. Which means that if pigs are limited, nutrient wise, at early growth stages they are not capable of developing at the same level as of pigs that were not limited. This could indicate genetic/ cellular reprogramming due to nutrient deficiency intake at early stages. Madsen and Bee (2014) evaluating whether the compensatory growth feeding strategy could be a suitable solution for overcoming the negative effects on growth, carcass composition and meat quality of low weight pigs, concluded that as far as body composition and feed efficiency are considered, one could conclude that restricting dietary nutrient intake is the feeding strategy of choice for pigs that have gone through previous growth restrictions.

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4. Conclusion

The easy availability of fresh flavoured feed in nursery pens has a positive effect on voluntary feed intake and consequently overall nursery phase performance, which impacts positively on piglet growth rates. Our results also indicated that there is a direct correlation between nursery end BW and finisher performance. Pigs that ate more also gained more weight and were heavier at the end of nursery, and also grew faster and were heavier at slaughter than the control pigs. This higher BW at slaughter also reflected on higher carcass performance traits. Our findings also indicated that although there can be a compensatory feed intake in pigs that experienced a lower feed intake and developed less during nursery and early growing stages, this still does not reflect in an improvement of growth rate and deposition efficiency. Therefore, we can conclude that the use of feed flavours is an important tool to reduce post-weaning stress and enhance piglet performance during nursery which impacts positively on finisher output performance and carcass traits. Furthermore, additional studies are necessary to better understand the underlying mechanisms of flavors on sensory neural response in pigs.

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