PORK QUALITY OF FINISHING PIGS FED DIET WITH LOW NUTRIENT LEVELS

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Abstract – For formulating pig diets, tabulated nutritional requirements are commonly used, which are established with a margin of safety in order that all animals express the maximum response, which may result in greater amount of nutrients excreted. The aim of this study was to evaluate nutritional programs, reducing dietary nutrient levels, through InraPorc® modelling software on meat quality of finishing pigs. Forty females and 40 barrows were used, distributed in a randomized block design with initial body weight and sex serving as the blocking factors, with two treatments and 10 replicates per treatment, with four animals per experimental unit. The finishing period was divided in two phases. Diets were formulated for each phase, one of the treatments adjusted by InraPorc® model (D1) and the other was the control diet (D2) formulated with tabulated values [3]. Color parameters (L*, a* and b*), pH, drip loss, marbling and color scores, evaluated on loin and ham, were not affected (P> 0.05) by diet. The results showed that the nutritional adjustment is a viable alternative to commercial diets used in Brazil.

I. INTRODUCTION

Currently, the feed formulation method used in industry is the linear minimum cost, which, respecting a set of linear constraints, determines the level of incorporation of an ingredient that will provide the lowest ultimate cost per kg of feed [1]. Commonly, nutritionists use nutritional requirements arising from tables developed in research centers to formulate pig diets. In these publications, the nutritional recommendations are established considering a margin of safety, so that all animals express the maximal response (weight gain, protein deposition), because the same recommendation is addressed to heterogeneous populations. However, the high nutrient concentrations found in swine manure [2] have caused discussions aiming the development and implementation of nutritional methods to reduce the environmental impact of pig production, maintaining the same pork quality parameters. Thereby, the InraPorc® software could be an efficient tool to adjust the nutrient level of diets according to the real requirements of the animal, with minimum excess. However, in Brazil, there is no application of this model beyond the research context. The aim of this study was to evaluate the effect of dietary programs with reduced crude protein (CP), total phosphorus (TP) and amino acids (AA) levels in the diets of pigs, by using InraPorc® software, on pork quality.

II. MATERIALS AND METHODS

Forty females and 40 barrows were used, distributed in a randomized block design with initial BW and sex serving as the blocking factors, with two treatments, 10 replicates/treatment, and four animals per experimental unit. The experimental period was 49 days to data collection, and the average initial body weight (BW) was 79.91 kg. The finishing period was divided in two phases. Diets were formulated for each phase, according to the treatments: diet adjusted by InraPorc® model, reducing the dietary CP, AA and TP levels (D1), and control diet formulated with tabulated values (D2) [3].

Forty five minutes after the slaughter the measurement of pH (pH45m) and temperature on the loin (*longissimus thoracis*) and ham (*semimembranossus*) was carried out. After 24 hours of cooling at temperature ranging from 2-8ºC, the pH was measured again (pH24h) and samples were collected for further analysis. The marbling score (loin) and subjective color (loin and ham) was performed after 20 minutes of

exposure to air, allowing the stability of the pigments [4].

The color was also measured by CIE Lab system (L*, a*, b*) with the aid of a Minolta colorimeter (Minolta Camera Ltda., Japan). The drip loss followed procedures suggested by the American Meat Science Association [5]. The drip loss was obtained by weight difference of meat sample, between eight and 12 g, before and after refrigeration, and the data was expressed in percentage of initial weight [6].

Diets were analysed for dry matter, nitrogen, calcium and phosphorus following the procedures of the Association of Official Analytical Chemists [7]. Data were subjected to analysis of variance using the GLM procedure of SAS [8], considering the effects of treatment, block (initial BW), sex, and treatment and sex interaction. When interactions were significant, their means were compared by Tukey test ($P<0.05$).

III. RESULTS AND DISCUSSION

Nutritional adjustment by InraPorc® software provided 8.92% of reduction in the TP level in phase finishing I and 15.35% in phase finishing II. In phases finishing I and II, there was a reduction of 9.41 and 21.39%, respectively, in digestible lysine, 5.77 and 18.53%, respectively, in methionine, and 3.23 to 14.81%, respectively, in tryptophan. In the phase finishing II the threonine level was reduced by 18.63%. CP was reduced by 8.31 and 11.06% at finishing I and II phases, respectively (Table 1).

Treatments did not affect ($P>0.05$) the pork quality standards evaluated in the loin and ham (Table 2), except for the a* value of the ham, which was higher in the pigs fed D1.

Table 1. Chemical and calculated composition of the experimental diets.

Stuffs	FI - 80-105 kg		FII - 105-130 kg	
	D1	D2	D1	D2
Corn	81.099	75.099	83.426	79.728
Soybean meal	16.582	22.389	14.580	17.962
Dicalcium phosphate	0.595	0.829	0.539	0.759
Limestone	0.751	0.664	0.688	0.606
Soybean oil	0.188	0.194	-	-
Salt	0.309	0.309	0.404	0.404
L-Lysine	0.158	0.183	0.103	0.211
Vitamin premix[1]	0.150	0.150	0.150	0.150
Mineral premix[2]	0.100	0.100	0.100	0.100
L-threonine	0.030	0.044	-	0.047
DL-methionine	0.024	0.040	-	0.030
L-tryptophan	0.005	-	-	0.003
Phytase[3]	0.010	-	0.010	-
Composition (as-fed)				
ME (kcal.kg^{-1})*	3230	3230	3230	3230
DM (%)**	87.79	87.86	88.41	88.21
CP (%)**	14.78	16.12	12.55	14.11
Ca (%)**	0.800	0.720	0.461	0.421
P avaiable (%)*	0.270	0.248	0.257	0.231
Total P (%)**	0.439	0.482	0.386	0.456
Dig lys (%)*	0.751	0.829	0.588	0.748
Dig met (%)*	0.245	0.260	0.189	0.232
Dig thre (%)*	0.556	0.555	0.415	0.510
Dig try (%)*	0.150	0.155	0.115	0.135

FI, finishing I phase; FII, finishing II phase; [1] Content.kg^{-1} product: Vit. D3, 150000UI; Vit. E, 15000UI; Vit. K3, 1500mg; Vit. B1, 1350mg; Vit B2, 4000mg; Vit B6, 2000mg; Vit. B12, 20000mcg; Pantothenic acid, 9350mg; Niacin, 20g; Folic acid, 600mg; Se, 300mg; Biotin, 80mg; Vit. A, 6000000UI; [2] Content.kg^{-1} product: Zn, 100g; Cu, 10g; Fe, 100g; Mn, 40g; I, 1500mg; Co, 1000mg; [3] Content.kg^{-1} product: 5000FTU.g^{-1}; *, Calculated composition; **, Analysed composition; ME, metabolizable energy; CP, crude protein; Ca, calcium; P, phosphorus; Dig, digestible; Lys, lysine; Met, methionine; Thre, threonine; Tryp, tryptophan.

Teye *et al.* [9] suggest that if the CP level of the diet had no effect on drip loss, pre-slaughter conditions were appropriate and the pH and water holding capacity evolved normally. In the present study, the drip loss mean in loin was 6.64% and 3.19% in the ham and the final pH of the meat was 5.60 and 5.70 for loin and ham, respectively.

In this study there was no statistical difference ($P>0.05$) for marbling score, with a mean value of 1.97. Pigs that consumed diets with lower CP have higher intramuscular fat [10]. That is

because low CP diets provide smaller animal energy expenditure to deaminate the excess of AA, resulting in more net energy in the diet, which may reflect the increased fat deposition in the carcass. Thus, we can conclude that in the present study the dietary CP, TP and AA reduction did not caused deficiency of these nutrients to the animal, which maintained the same standards of pork quality.

The sex-treatment interaction was significant ($P<0.05$) for the pH24h in the loin and ham temperature 45 minutes after slaughter. The pH was higher for barrows (5.70) compared to females (5.60), for animals fed D2. Despite the significant interaction, the values are within those observed in previous studies [11] and within the range considered for normal pork quality [4].

Table 2. Pork quality of finishing pigs fed diet with low nutrient levels (D1) and recommended values (D2).

	Treatments		P-value		RSE
	D1	D2	Treat	Int	
Loin					
L*	46.30	46.00	0.708	0.388	2.306
a*	3.78	3.66	0.667	0.248	1.028
b*	4.56	4.46	0.812	0.464	1.054
pH45m	6.30	6.40	0.133	0.106	0.177
pH24h	5.60	5.60	0.704	0.010	0.108
Temp 45m	26.50	26.60	0.135	0.988	0.716
Corlor[1]	3.78	3.53	0.460	0.195	0.955
Marbling[2]	2.13	1.80	0.152	0.377	0.729
Drip loss (%)	6.07	7.20	0.527	0.738	2.607
Ham					
L*	43.40	44.00	0.472	0.661	2.452
a*	6.10	5.33	0.018	0.833	1.018
b*	4.95	4.89	0.893	0.587	1.171
pH45m	6.50	6.50	0.435	0.260	0.175
pH24h	5.70	5.70	0.235	0.071	0.096
Temp 45m	26.60	26.80	0.122	0.044	0.624
Color[1]	3.80	3.88	0.450	0.065	0.629
Drip loss (%)	3.40	3.17	0.520	0.705	1.346

pH45m, pH 45 minutes after slaughter; pH24h, pH 24 hours after slaughter; Temp 45m, temperature 45 minutes after slaughter; [1] color score; [2] marbling score; P, probability; Treat, treatament; Int, interaction; RSE, residual standard error; L*, luminosity (L, 0 = black; 100 = white); a*, red color intensity; b*, yellow color intensity; 45', 45 minutes after the slaughter; 24h, 24 hours after the slaughter.

IV. CONCLUSION

The results of this study demonstrate the potential for reduction of nutrient levels used in pig diets formulation in Brazil, because they are apparently above the real requirement of the finishing pigs, since the reduction of dietary CP, TP and AA level did not affect the pork quality in the conditions evaluated in this study. Moreover, this dietary adjustment can be an efficient way to minimize the environmental impact of these nutrients, and InraPorc® software is a viable option to reduce the dietary nutritional level maintaining the pork quality standards.

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