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The fiber in the diet of Iberian pigs and ability to limit growth

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Abstract. In order to limit the growth of Iberian pigs during the rearing period, is to consider to include in the diet fibrous material, to reduce food intake under *ad libitum* feeding and thus energy. Incorporation levels are 300, 450 and 600 g kg^{-1}, using as fiber source, sugar beet pulp (as soluble fiber) and cereal straw (as insoluble fiber). A total of 20 pure Iberian pigs was used (into 5 groups of 4 pigs each). The pigs started the experiment with 84 kg of live weight and remains in the experiment for 4 weeks, to reach a live weight of 102 kg. Growth and feed intake was controlled and average daily gain and feed conversion was determined. The *ad libitum* intake of 300 to 600 g kg^{-1} of fiber produces a decrease in all the productive parameters except in feed conversion. The effect of the type of fiber over the feed intake was significant with B-coefficients of -0.039 for SBP and -0.052 for CS. The cereal straw has a major effect in the decrease of the intake than the sugar beet pulp.

Keywords. Fiber – Feed – Growth – Iberian pig.

Les fibres dans l'alimentation des porcs Ibériques et leur capacité à limiter la croissance

Résumé. *Afin de limiter la croissance des porcs Ibériques au cours de la période d'élevage, il est à envisager d'inclure des matériaux fibreux dans le régime alimentaire* ad libitum*, afin de réduire la consommation alimentaire, et donc l'énergie. Les niveaux d'incorporation sont de 300, 450 et 600 g kg^{-1}, en utilisant comme source de fibres, de la pulpe de betterave sucrière (fibres solubles) et de la paille de céréales (fibres insolubles). On a employé un total de 20 porcs Ibériques purs divisés en 5 groupes de 4 porcs chacun. L'expérience a commencé à 84 kg de poids vif, et les porcs sont restés pendant 4 semaines jusqu'à ce qu'ils atteignent un poids de 102 kg. L'ingestion de 300 à 600 g kg^{-1} de fibres produit une diminution des paramètres productifs excepté l'indice de conversion alimentaire. Concernant l'effet du type de fibre, il a été observé que l'ingestion a été significative avec les coefficients de B (- 0,039) pour SBP et (- 0,052) pour CS. La paille de céréale a davantage d'effet dans la diminution de la consommation que la pulpe de betterave.*

Mots-clés. *Fibres – Croissance – Porc ibérique.*

I – Introduction

The legislation of the products of the Iberian pig (RD 1469/2007 of November 2, 2007), that the animals must reach, for his entry in fatten or "montanera", a not excessively high weight (between 92 and 115 kg) and to comply a few minimal requirements of age of sacrifice and permanency according to type of finish fattening. To obtain this aim, from 23 kg and 3 months of life, up to ten-twelve months of age, there have to be obtained average daily gain of 270-440 g/día, really low for his potential of growth. It is necessary to offer a balanced and efficient diet (Barea *et al*., 2007) that produces animals with a good conformation at the conclusion of the phase of growth and with a suitable skeletal structure and muscular development to confront the finish fattening period.

The strategy used in the sector of the Iberian pig is to restrict the diet, administering of form rationed during the period of growth. The disadvantage of this system is in the managing, in which it is necessary to administer the feed in a ration daily, with the consequent workforce that it carries. Another disadvantage derived from the rationing is the low level of satiety reached, causing problems of behavior and inequality between them. To administer the diet *ad libitum* would be a solution but the Iberian pig have a high capacity of ingestion and a minor mean retention time of the digesta (Nieto *et al*., 2001; Morales *et al*., 2002), which is unviable for excessive average weight in period to entry in "montanera". It would be so interesting, to have a possibility to be able administer a diet *ad libitum*, with a low energetic concentration based on the use of fibrous raw materials in a high percentage and that produces a high satiety to give solution to this problem.

The aim is to study the possibility of including in the diet of growing Iberian pigs (84-102 kg of body weight) dietary fiber, for limit the energy consumption and administer the diet a*d libitum*.

II – Materials and methods

A total of 20 Iberian pigs barrows males divided in five lots was used. Sugar beet pulp SBP(as soluble fibre) and cereal straw CS (as insoluble fibre) commercially available were incorporated as the major fiber sources in diets according to the scheme presented in the Table 1. The diets were milled to pass through a 2 mm screen diameter and presented as granule. The chemical composition of the diets is presented in Table 1. The diets contained similar crude protein contents and total amino acids, calcium and phosphorus levels and were balanced for metabolizable energy (ME).

Table 1. Content of fiber sources (g kg^{-1}) and chemical composition (g kg^{-1} dry matter) on the experimental diets

Diets	1	2	3	4	5
Sugar beet pulp	150	300	150	225	300
Cereal straw	150	150	300	225	300
Crude protein	142	150	148	157	153
NDF†	280	350	382	407	420
ADF†	151	170	230	199	234
ADL†	17	21	25	22	27
Hemicellulose††	129	180	152	208	187
Cellulose††	134	148	206	177	207
ME (mcal kg^{-1} fresh matter) †††	2.45	2.40	2.35	2.39	2.33

†NDF: neutral detergent fiber, ADF: Acid detergent fiber ADL: acid detergent lignin.
††Hemicellulose and cellulose are NDF-ADF and ADF-ADL, respectively, according to Van Soest *et al*. (1991).
†††Calculated for tables FEDNA 2003.

The body weight (BW) of pigs were determined at the beginning and the end of the experiment and feed consumption was determined daily by weighing the feed offered and refused. Daily BW gain and feed conversion ratio were calculated. The pigs started the experiment with an average live weight of 84 kg and remained there for 28 days, up to 102 kg of live weight.

The experimental design of the investigation was the response surface methodology applied to a full factorial central composite design with two independent variables (amount of SBP and amount of CS) at two levels (150 and 300 g kg^{-1} levels) obtaining the corresponding response. Four replicates at the centre points were also considered.

Regression analysis of the data obtained and estimation of the coefficients of the regression equation was realised. The fit of the regression model attained was checked by the Correlation coefficients. The Unscrambler software (Version 9.7, Camo Software AS OSLO, Norway 2007) was used for regression and the graphical analyses of the data obtained.

One-way ANOVA determined significant differences between groups. Differences between means were tested by Tukey's least significant. Dates are presented as means and standard error of the mean (SEM) and the animal was the experimental unit. These statistical analyses were performed using SPSS (version 15.0).

III – Results

In the Table 2 are presented the performance results. A significant effect of experimental diet was observed between a level **5** of incorporation of fiber (600 g kg^{-1}) and level **1** (300 g kg^{-1}) with ($p< 0.05$). Feed intake was affected by diet, was observed a decrease with an increasing of dietary fiber. Equally was observed in the live weigth and in the average daily gain decreases with increase of fiber. The voluntary intake is depressed when fiber is increased in the diet for effect of satiety (Cole *et al*., 1971). The administration of fiber reduced the feed intake of the animals, and increased the weight of gastro-intestinal tract content (Anguita *et al*., 2006).

Table 2. Effect of dietary diet on performance of pigs in 28 days of experiment period

Diets	1	2	3	4	5	SEM	p-value
Live weight increase (kg)	23.0 ^{a}	19.4 ^{ab}	17.9 ^{ab}	17.1 ^{ab}	15.0 ^{b}	1.035	*
Feed intake (kg per day)	4.47 ^{a}	3.91 ^{ab}	3.71 ^{ab}	3.79 ^{ab}	3.10 ^{b}	0.149	*
Average daily gain (kg per day)	0.821 ^{a}	0.692 ^{ab}	0.638 ^{ab}	0.611 ^{ab}	0.536 ^{b}	0.037	*
Feed conversion ratio	5.7	5.7	6.4	6.3	5.9	0.301	ns

SEM. Standard error of the means.
Means with the different letters on the same line are significantly different * $p< 0.05$ ns: no significant.

The effect of type of fiber is presented in Table 3. The feed intake was significant with B-coefficients of -0.039 for SBP and -0.052 for CS. This indicate that the straw has a major effect in the decrease of the intake that the sugar beet pulp. About the average daily gain, though the model is adjustment, was observed that the effect of SBP is not significant but the effect of straw is it ($p= 0.031$). All this is illustrated in Fig. 1 where are presents the effect of the factors amount of SBP and CS for feed intake (a) and average daily gain (b). It showed clearly that the inclination of the planes is different according to the source of fiber.

Table 3. Regression model fit with parameter estimates and correlations coefficients

		B-coefficients	p-value	Correlation coefficients
DFI	Model		0.006	0.675
	Intercept	3.796	0.000	
	SBP (A)	-0.039	0.037	
	CS (B)	-0.052	0.008	
ADG	Model		0.036	0.569
	Intercept	0.659	0.001	
	SBP (A)	-0.008	0.126	
	CS (B)	-0.011	0.031	

This result is in disagreement with other studies that the inclusion of sugar beet pulp in the diet reduced the voluntary feed intake of pigs more than other less digestible ingredients (Brouns *et al*. 1991). The type of fiber cause different effect in digestive process, saciety and digesta transit time (Caspar *et al*., 2001). The effect of saciety is associated to high amount of soluble dietary fibre which causes an increased volume of digesta. Is probably that the determinant factor limiting ingestion is the water retention capacity of soluble fiber (Kyriazakis *et al*., 1995). The effect of genotype of Iberian pig was contrasted for feed intake and digestibility coefficients (Morales *et al*., 2002) but there are not sufficient studies of digestive process of fiber and transit time in Iberian pig.

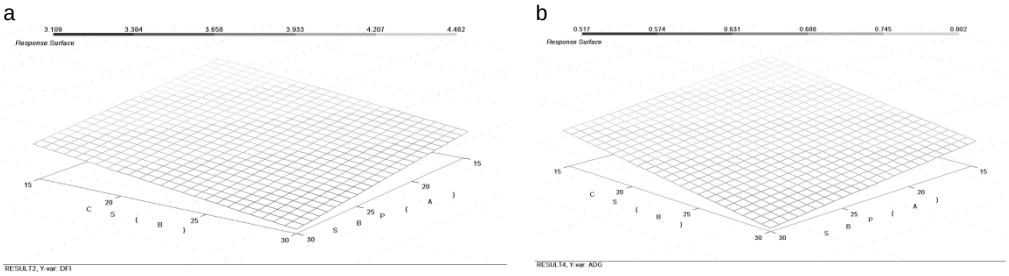

Fig. 1. Response surface plot of the effect of sugar beet pulp and cereal straw on the daily feed intake (a) and average daily gain (b).

IV – Conclusions

The results of the present study show that an increase of fiber in the diet produces a decrease in the productive parameter except in feed conversion. Is more efficient to control the capacity of ingestion of the Iberian pig and decrease his potential of growth at least 60 % of level of incorporation of fiber with a similar feed conversion that other percentage of incorporation. In parallel, the straw has a major effect in the decrease of the intake that the sugar beet pulp.

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