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Effect of beet pulp on growing performance, digestibility, N balance, and ammonia emission in the heavy pig

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RIASSUNTO – Effetto delle polpe di bietola disidratate su prestazioni zootecniche, digeribilità, bilancio dell'azoto ed emissioni ammoniacali nel suino pesante. *Scopo del lavoro è stato quello di valutare in che misura l'inclusione nella dieta di un alimento ricco in carboidrati non amidacei ben digeribili, quale le polpe di bietola disidratate, influenzi le emissioni ammoniacali dalle deiezioni e le prestazioni zootecniche del suino pesante tipico italiano nella fase finale del ciclo di ingrasso. In 12 box sono stati stabulati 72 suini, da 106 a 170 kg di peso, per testare tre diverse diete contenenti 0 (C), 15 (BP1) e 30% (BP2) di polpe di bietola disidratate. Con le diete contenenti polpe di bietola è stata registrata una maggior escrezione fecale di N, ma una minor escrezione urinaria e una ridotta emissione di NH_3 dalle deiezioni. Le prestazioni zootecniche sono risultate simili per le diete C e BP1 e leggermente peggiori per BP2.*

Key words: beet pulp, pig, ammonia emission, N balance.

INTRODUCTION – A relevant aspect of pig farm units concerning the environmental impact is the ammonia emission from slurries, which is detrimental for animal (and sometimes also for human) welfare. This emission is co-responsible for acid rains, for the increase of bad smells and is detrimental for the respiratory apparatus (Portejoie *et al.*, 2002).
In the last years some researches were made, particularly in Nothern Europe (Peet-Schwering *et al.*, 1999) to investigate the relationships between feeding and Nitrogen excretion (Fernandez *et al.*, 1999), with a special emphasis on ammonia emissions (Canh *et al.*, 1997; Canh *et al.*, 1998a; Canh *et al.*, 1998b; Kreuzer *et al.*, 1998; Ly *et al.*, 2003). In these works the influence of some dietetic factors, particularly the content of non starch polysaccharides (NSP), on ammonia emission and the pH of pig slurry in the typical north European conditions, are highlighted.
Aim of the work was to evaluate, in the typical heavy Italian pig, the influence of beet pulp, a raw material rich in highly digestible NSP, on faecal and urinary Nitrogen excretion and on ammonia release from slurries. Digestibility and growing performance of the pigs were also registered.

MATERIAL AND METHODS – 72 Landrace x Large White barrows were divided into three groups fed different diets. The animals of each group were allotted to 4 pens of six pigs. On average the animals weighed 106 kg at the beginning of the trial and 170 kg at slaughter. Average daily gains (ADG) were calculated weighing the pigs at start, after 23 and 58 days and at the end of the trial. Feed conversion ratios (FCR, kg DM/kg ADG) were computed per pen, in the same phases of the trial as for the ADG. Feeding was restricted and, on average, the dry matter fed was 2.25 kg/d.
Control diet: 54% maize meal, 30% barley meal, 8% soybean meal, 5% wheat bran, 1% sugarcane molasses, 2% mineral/vitamin and lysine supplement. High NSP diets included 15% (diet BP1) and 30% (diet BP2) dried beet pulp in substitution of wheat bran and maize meal; BP1 and BP2 included also 1 and 2% palm oil respec-

tively, to facilitate pelleting.
Digestibility was measured on 18 pigs selected from the 72 on experiment. Average bodyweight during digestibility was 154 kg. Digestibility experiments were performed following the indications of the Feed Evaluation Commission of the Italian Scientific Association for Animal Production (ASPA, 1982). DM supply during digestibility was 6.2% of the metabolic weight ($MW=BW^{0.75}$) on average, similar to that of the other pigs on trial located in the pens of the fattening unit. Water was supplied *ad libitum*. During each digestibility period samples of urine, in addition to those of the faeces, were collected to determine N balance.
Chemical analyses of feeds and excreta were performed following the indications of ASPA (1980).
Ammonia emission from slurries were measured as indicated by Derikx and Aarnink (1993). Following this procedure, 2 kg excreta are put in a vessel with a lid connected to a tube system. The air (with the produced ammonia) streams, bubbling, through a HNO_3 solution (0.5 M) which retains the ammonia. A continuous air streams is determined by pumps located at the end of the tube system. In our experiment 2 kg excreta per dietary treatment were used for ammonia emission and pH determination for 14 consecutive days, with daily recording.
Data were statistically analysed by GLM procedure (SAS, 2001).

RESULTS AND CONCLUSIONS – The chemical composition (% on DM) of diets C, BP1 and BP2 were respectively: 13.2, 12.7, 12.5 CP; 14.2, 15.8, 20.9 NDF; 5.4, 7.7, 11.6 ADF; 55.1, 46.0, 34.4 starch. Table 1 reports the data on digestibility and N balance referred to the three diets. In agreement with the results of other experiments (Canh *et al.*, 1997, Galassi *et al.*, 2004, Scipioni *et al.*, 1993), the diets containing beet pulp determined a higher N faecal excretion which was balanced by a lower N urinary excretion. As a result N retention was quite similar for all the diets.

Table 1. Apparent faecal digestibility (%) and Nitrogen balance ($MW=BW^{0.75}$).

		C	BP1	BP2	ES	C *vs.* BP1	C *vs.* BP2	BP1 *vs.* BP2
Dry matter		86.3	86.7	85.0	0.69	NS	NS	NS
Organic matter		88.4	89.1	88.0	0.61	NS	NS	NS
Nitrogen		84.5	80.6	76.9	1.14	*	***	*
Ether extract		80.7	86.5	83.5	1.40	0.079	NS	NS
Crude fibre		54.2	68.5	70.9	2.50	**	***	NS
NDF		51.8	64.9	71.3	2.52	**	***	0.092
ADF		45.1	64.2	70.9	2.78	***	***	NS
Energy		86.5	87.1	85.2	0.68	NS	NS	NS
Bodyweight (BW)	(kg)	154.5	156.9	152.0				
Intake N (IN)	g/d	56.6	56.0	53.7	0.31	NS	***	***
	g/kg MW	1.29	1.26	1.24	0.006	**	***	*
Faecal N	g/kg MW	0.20	0.24	0.29	0.014	*	**	*
	% IN	15.5	19.4	23.1	1.14	*	***	*
Urinary N	g/kg MW	0.61	0.56	0.49	0.030	NS	*	0.121
	% IN	47.1	44.4	39.6	2.43	NS	0.126	NS
Retained N	g/kg MW	0.48	0.46	0.46	0.036	NS	NS	NS
	% IN	37.4	36.3	37.3	2.73	NS	NS	NS

* = P<0.05; ** = P<0.01; *** = P<0.001.

The daily and cumulative ammonia emission rates are shown in Figure 1. After 14 days 494.6, 451.9 and 271.6 mmol NH_3 (equal to 6.92, 6.32 and 3.47 g N) were emitted by the slurries from C, BP1 and BP2 diets. As compared to C, the reduction of ammonia emission was 8.7% for BP1 and 44.8% for BP2. However, since the 2 kg of slurries used to evaluate ammonia emission were respectively 56, 54 and 43% of the average daily amount of slurry for C, BP1 and BP2 diets, the effective decrease in ammonia emission *versus* C, referred to the slurry produced, were 8.5% for BP1 and 33.0% for BP2.

The pH values of slurries were lower for diets with high NSP and, at the end of the 14 days, they were 8.72, 8.45 e 8.24 for C, BP1 and BP2 diets, respectively.
Throughout the whole experimental period, in comparison with diets C and BP1, diet BP2 showed the lowest ADG (0.63, 0.64 and 0.56 kg, respectively; $P<0.05$) and the worst FCR (3.94, 3.96 and 4.42; $P<0.01$). For both ADG and FCR the negative performances have to be attributed mainly to the first period of fattening (106-120 kg), with ADG of 0.57, 0.65, 0.40 kg/d ($P<0.01$) and FCR equal to 3.81, 3.69, 5.31 ($P<0.01$) for C, BP1 and BP2, respectively. From 120 to 170 kg bodyweight the ADG and the FCR recorded were quite similar for the three treatments.

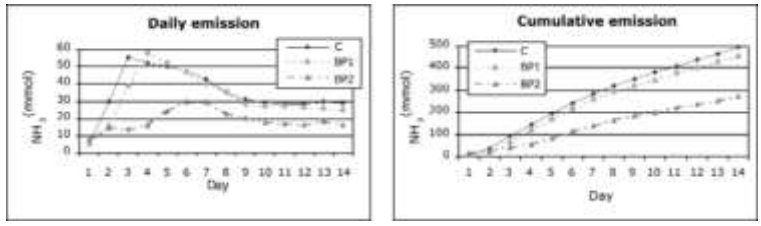

Figure 1. Ammonia emission from 2 kg of slurry during 14 days.

The increased content of NSP in the diet, obtained by the addition of beet pulp, has determined the reduction of the productive performances of the pigs weighing less than 120 kg. Considering that, according to the Productive Disciplinary of Parma and S. Daniele Hams, the Italian heavy pig must be slaughtered after 9 months of age at 160 kg BW (+/-10%), it seems possible to include 15-20% of dried beet pulp in the diet of the final phase of the fattening pig (>120 kg BW) to reduce the ammonia emission from slurries without affecting productive performance.

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