SWEET POTATOES *(IPOMOEA BATATAS)* IN HEAVY PIG FATTENING[1]

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SUMMARY: Seventy-five Large White castrated males, divided into 3 groups, were used. The control group was given traditional feed with no sweet potatoes, while the two treated groups received diets containing 20 and 40% sweet potatoes in place of the equivalent amount of maize meal. Daily gain and feed efficiency were lower in the treated groups and the dressing percentage was better for the control group (82.17 *vs* 81.10 and 80.94% for the control group and those fed 20 and 40% sweet potatoes respectively). This difference was significant while the treatment did not affect the other parameters considered at slaughter: carcass length, pH of muscle *semimembranosus* measured at 45 minutes *post mortem*, lean meat content of carcass. Furthermore, no significant differences were found as reguards weight of the different cuts of the left half-carcass. Moreover, the values assessed for the ham showed no significant differences. The parameters evaluated were: colour, pH and cooler shrinkage 24 hours after slaughter and weight loss 84 days after slaughter. It may be concluded that sweet potatoes reduce daily gain and dressing percentage in heavy pig fattening, while do not influence carcass or meat quality traits.

INTRODUCTION: Throughout the European Economic Community there is an extensive use of by-products to replace cereals in farm animal feed. In recent years dried sweet potatoes *(Ipomoea batatas)*, imported from China, have appeared on the market; these are generally marketed in sliced form and only rarely as pellets.

There is little literature dealing with the use of sweet potatoes in feeding farm animals, and the few trials carried out with pigs used animals slaughtered at low weights.

(1) Research carried out with a grant from Ministero della Pubblica Istruzione. This research is part of the programme of research of the EMILIA-ROMAGNA Region and was carried out with the coordination of C.R.P.A. (Research Center for Animal Production).

Heavy pig production (with a slaughter weight of 150-160 Kg) predominates in Italian pig-farming due to the fact that the characteristic and most important product is the raw ham. To ensure the quality of this ham, which is aged for a period of not less than 12 months, the animals must be neither too young nor too light at slaughter.

The aim of this research was therefore to assess the effect on carcass and meat quality of feeding dried sweet potatoes to heavy pigs.

MATERIALS AND METHODS: A total of 75 Large White castrated males, with an average initial live weight of about 42 Kg, were divided into 3 groups of 25 subjects each and fed concentrate mixtures given as meal three times daily.

The control group was given a traditional feed with no sweet potatoes (SP), while the two treated groups received diets containing 20% and 40% sweet potatoes in place of an equivalent amount of maize. Once the animals had reached a live weight of 110 Kg the protein content of the diets was slightly reduced. The percent composition of the feed and the chemical composition of the sweet potatoes and of the experimental diets are reported in Tables 1 and 2. The digestible energy of the sweet potatoes and of the experimental diets was calculated using the equation proposed by EWAN (1988).

The animals were slaughtered at a live weight of approximately 156 Kg and the following parameters were evaluated:

a) weight of warm carcass

b) carcass length (from pubic symphysis to first rib)

c) backfat thickness (including skin) measured in two places. The first point (x_1), over M. *glutaeus medius* at the thinnest place at the mid-line, was measured using a metal meter. An optic probe (Intrascope, produced by SFK Ltd, Hvidrove, Denmark) was used for the second point (x_2), between the 3rd and 4th from last rib, at 8 cm from the mid-line. These measurements enabled the percentage of carcass lean meat content to be calculated by means of the official equations used in Italy and approved by EEC (1989).

d) pH, measured 45 minutes after slaughter, over M. *semimembranosus* using a KNICK 751 pHmeter connected to an INGOLD electrode of xerolyt type (electrolyte made of stiff polymer mass containing KCl but free from AgCl).

e) colour, measured on the freshly cut surface of the M. *semimembranosus* using a MINOLTA CHROMAMETER CR-200 Colorimeter with C as a light source and calibrated with a standard Gardner pink tile n. CG 6625 (Y= 45.97; x=0.3658; y=0.3250). The chromatic co-ordinates of the sample were expressed using the system of values L* a* b*.

The left half-carcass of each animal was dissected and the weight of the

Table 1 - **Percent composition of experimental diets**

Ingredients	1st Period			2nd Period		
	Control	20% SP	40% SP	Control	20% SP	40% SP
Sweet potatoes meal	0.0	20.0	40.0	0.0	20.0	40.0
Maize meal	40.0	20.0	0.0	40.0	20.0	0.0
Barley meal	24.0	22.0	21.0	30.0	28.0	27.0
Wheat bran	12.0	12.0	10.0	12.0	12.0	10.0
Soybean meal, solv. (44% prot.)	20.0	21.5	24.0	14.0	15.5	18.0
Animal fat (lard)	1.0	1.5	2.0	1.0	1.5	2.0
Phosphorus supplement	1.3	1.3	1.3	1.3	1.3	1.3
Calcium carbonate	1.1	1.1	1.1	1.1	1.1	1.1
Premix	0.5	0.5	0.5	0.5	0.5	0.5
L-Lisine chlorhydrate	0.1	0.1	0.1	0.1	0.1	0.1

following cuts was determined: ham, loin + Boston butts + ribs, shoulder with foot, belly, backfat, jowl, flare fat, head, hind foot. A sample of *psoas maior* muscle was taken from each left side to assess the water holding capacity, which was determined on 300 mg using GRAU and HAMM's (1956) method.

For the first 24 hours after slaughter the hams were stored in a chilled room at -5°C, with the ham reaching a temperature of 1-2°C.

Twenty-four hours after slaughter the pH and the colour of the *semimembranosus* muscle were determined as well as ham cooler shrinkage.

The hams then underwent the normal processing stages (salting and resting) and were weighed again at the end of the resting stage (in this trial at 84 days after slaughter).

The trial will be finished next month, in September, when the 12-month ageing period for the hams ends and their quality may be assessed.

Data were analyzed using analysis of variance or covariance. Where significant F values for treatment effects occurred, means were evaluated by DUNCAN's multiple range test (STEEL and TORRIE, 1960).

Table 2- **Chemical composition of experimental diets and dried sweet potatoes (SP)**

		1st Period			2nd Period			
		Control	20% SP	40% SP	Control	20% SP	40% SP	SP
Dry matter	%	88.80	89.36	89.19	87.35	87.29	87.17	90.82
Crude protein	% dm	18.99	18.69	17.82	17.17	16.72	16.45	5.01
Ether extract	" "	3.23	3.69	3.34	4.50	4.13	4.01	0.82
Crude fiber	" "	5.22	5.33	5.26	5.48	5.57	5.96	3.20
NDF	" "	15.61	14.62	14.49	16.24	16.52	16.96	9.75
ADF	" "	7.81	7.69	7.41	7.60	8.10	8.41	7.77
ADL	" "	1.47	1.06	1.36	1.32	1.35	1.45	1.02
Ash	" "	5.11	5.92	6.43	5.40	5.85	6.47	3.40
N-Free extract	" "	67.45	66.37	67.15	67.45	67.73	67.90	87.57
Calcium	" "	0.72	0.77	0.78	0.87	0.98	1.04	0.20
Phosphorus	" "	0.71	0.61	0.60	0.74	0.69	0.67	0.14
Digestible energy MJ/Kg dm		15.48	15.57	15.32	15.61	15.40	15.23	15.07

RESULTS AND DISCUSSION:

a) Daily gain and feed efficiency

The results are reported in Table 3. Although the differences between the means are not significant, the daily gain is seen to decrease in the pigs given feed containing sweet potatoes and thus the feed efficiency tends to worsen.

It may therefore be concluded that the replacement of maize meal with dried sweet potato meal has an unfavourable effect on the pigs' growth rate.

b) Slaughter data

The dressing percentage (table 4) of the pigs from the treated groups is lower than that of the animals in the control group ($P < 0.05$).

However, no significant differences are seen between the three groups as regards carcass length, carcass lean meat content, water holding capacity, pH

Table 3 - **Liveweight, daily gain and feed efficiency**

Items		Control	20% SP	40% SP	F
no. of animals		25	25	25	-
Initial weight	Kg	40.9	40.7	45.1	1.22
Final weight	Kg	157.3	155.8	156.0	0.08
Daily gain	g	635	617	602	1.01
Feed conversion efficiency (Kg feed/Kg gain)		3.79	3.94	4.01	-

Table 4 - **Slaughter data**

Items			Control	20% SP	40% SP	F
Slaughter weight		Kg	157.3	155.8	156.0	0.08
Carcass weight		Kg	129.3	126.5	126.3	0.45
Dressing percentage		%	82.17 ^{a}	81.10 ^{b}	80.94 ^{b}	4.92
Carcass length		cm	94.53	94.25	94.35	0.04
Backfat thickness (x_1)		mm	28.30	29.40	29.80	0.53
Backfat thickness (x_2)		mm	30.90	29.10	29.80	0.45
Carcass lean meat content		%	49.07	49.35	48.83	0.15
pH (45 min *post mortem*)			6.29	6.36	6.43	1.08
Water holding capacity		cm^2	7.66	8.00	7.48	1.07
Colour (CIE Lab)	L*		37.76	38.40	38.08	0.45
	a*		5.77	5.59	5.46	0.20
	b*		1.80 ^{b}	2.43 ^{a}	2.34 ^{a}	4.60

(x_1) Over M. glutaeus medius, thinnest place at the mid-line

(x_2) Between the 3rd and 4th from last rib, 8 cm from the mid-line

a,b = $P < 0.05$

of the *semimembranosus* muscle and the colour of this muscle for the parameters L* and a*.

The b* value of the meat from the animals of the control group was lower than that of the treated groups ($P < 0.05$). While we are unable to find a reason for this difference, we consider it of little importance in light of the fact that the values determined 24 hours later do not confirm this phenomenon (see Table 6).

c) Carcass dissection

Table 5 reports the data concerning the left half-carcass dissection. No significant differences are observed between the mean weights of the cuts from the three groups; there is rather much similarity between the values found. This means that the treatment did not affect the carcass composition.

Table 5 - **Half-carcass dissection**

Items		Control	20% SP	40% SP	F
Left half-carcass wt	Kg	65.47	64.08	64.01	0.41
Ham	"	14.72	14.39	14.44	0.07
Loin + Boston butts + ribs	"	16.63	16.12	16.36	0.41
Shoulder with foot	"	9.02	8.77	8.61	1.56
Belly	"	7.82	7.91	7.51	1.65
Backfat	"	6.73	6.43	7.05	1.83
Jowl	"	4.47	4.37	4.38	0.02
Flare fat	"	1.75	1.77	1.74	0.33
Head	"	3.30	3.21	3.15	1.90
Hind foot	"	0.55	0.55	0.52	2.51

d) Ham traits

Table 6 reports the values of the parameters measured on the hams after 24 hours chilling as well as cooler shrinkage after this time. The pH of the three groups is very similar. Weight loss at 84 days from slaughter tends to be

greater in the hams from the pigs fed sweet potatoes compared to those of the control group; however the difference is not significant.

The values regarding colour (L*, a*, b*) are not statistically different between the three groups. It may be noted how these values, measured on the same muscle, changed after 24 hours (see Table 4). While value L* remained practically unchanged in the treated groups, in the control it increased, rising from 37.76 to 40.56. Values a* and b* increased from measurement on the warm carcass to that taken 24 hours later. However, whereas value a* increased

Table 6 - **Ham traits**

Items			Control	20% SP	40% SP	F
pH (1)			5.53	5.50	5.59	2.37
Colour (CIE Lab) (1)	L*		40.56	37.99	39.72	1.93
	a*		8.93	7.57	8.08	1.80
	b*		4.05	3.33	3.65	2.40
Cooler shrinkage (1)		%	4.41	4.56	4.53	0.93
Weight loss (2)		%	12.90	13.82	13.81	2.11

(1) 24 hours after slaughter
(2) 84 days after slaughter

uniformly in the three groups, value b* had a considerable increase only in the control group. It should be noted that it is normal for the colour co-ordinates to rise in the period after slaughter, as has been seen in previous research (CHIZZOLINI *et al*, 1989). It can be seen that a*: b* ratio is always greater than 2. This indicates a normal colour, as appreciated by the consumer.

We have been unable to find previous research on heavy pigs reported in the literature with which we could compare our results. Some trials conducted in Taiwan (LEE, 1977; LEE and LEE, 1981; LEE and YANG, 1981 and 1982; CHEN and YEH, 1982) on pigs slaughtered at much lower weights than those of the pigs of this trial showed that the replacement of cereals with sweet potatoes has, except in very few cases, an unfavourable effect on daily gain and feed efficiency, as well as on dressing percentage. The results of these studies are therefore in agreement with those of the trial reported here.

CONCLUSIONS: The results obtained, in the conditions under which we operated, show that sweet potatoes, as a replacement for maize meal, reduce

daily gain, decrease feed efficiency and reduce dressing percentage in pigs slaughtered at a weight of 156 Kg. Their use in the farming of heavy pigs could only be profitable therefore if they are marketed at a very low price.

Sweet potatoes do not affect carcass composition or carcass lean meat content for the heavy pig; neither are the pH (measured at 45 minutes and 24 hours after slaughter) or colour (24 hours *post mortem*) of the *semimembranosus* muscle influenced by the feeding of sweet potatoes.

A definitive assessment of the effect of sweet potatoes on the characteristics of ham quality may only be reached when the hams are marketed at the end of the 12-month ageing period.

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