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Effect of genetic type and dietary protein level on growth, carcass and ham traits of heavy pigs

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rationale

- Italian pig chain devoted to the production of heavy pigs for PDO hams supply
- PDO regulations rule (among others):
  - minimum body weight and age at slaughter
  - attributes of raw hams related to processing ability (weight, uniformity, amount and quality of fat,…)
- prescriptions about pig genetic type in PDO are vague, and different lines are used
- differences among genetic groups for this kind of production have been underexplored

aims

- this study was supported by AGER (grant 2011-0280) and aimed to investigate the effects of 4 genetic types:
  - Italian National Breeders Association (ANAS DU x LW)
  - DanBred
  - Goland
  - Topigs

  on growth performance, carcass and ham traits of fed-restricted heavy pigs intended for PDO ham production and kept on :
  - conventional “high” CP diet (CONV)
  - low CP and essential AA content diet (LP)

material and methods

Animals and experimental design

- 182 pigs (gilts and barrows) of 4 genetic types born in the same week
- 2 batches
- 8 pens (10 to 12 pigs/pen) with mixed GT and genders
- 2 diets (CONV or LP)
- 4 pens per diet within batch
- restricted feed intake: 2.4 to 3.2 kg/d feed from 85 to 165 kg BW
- slaughtering age : 9 months (avg BW:165 ± 12 kg)
- individual BW, P2 backfat and feed intake recorded

chemical composition of the diets

	CONV	LP	LP/CONV
Analyzed nutrient composition:			
DM, g/kg	871	872	
CP (N × 6.25), g/kg	140	106	0.76
Starch, g/kg	439	490	1.12
NDF, g/kg	163.5	165	1.01
Calculated nutrient composition (NRC, 2012)			
ME, MJ/kg	0.54	0.54	1.00
NE, MJ/kg	9.95	10.1	1.02
CP (N × 6.25) , g/kg	136.5	107	0.78
Fermentable fiber, g/kg	104.5	87.5	0.84
Calculated total amino acid content (NRC, 2012)			
lysine, g/kg	6.25	5	0.80
methionine, g/kg	2.3	1.95	0.85
threonine, g/kg	4.9	4	0.82
tryptophan, g/kg	1.6	1.25	0.78

slaughterhouse and ham factory

- after slaughtering, hot carcasses dissected into typical commercial cuts (***weight*** recorded)
- after 24-h of chilling, raw hams dressed (***weight*** recorded)
- all hams measured for ***subcutaneous fat thickness*** (ruler)
- left hams (*II batch only*) scored for ***round shape*** and ***marbling*** (0, low, to 4, high), ***meat color*** (-4, pale, to 4, dark) and ***fat thickness*** (-4, low, to 4, high)
- samples of subcutaneous fat from each dressed ham to assess ***iodine number*** (Wijs procedure)
- all hams without defects processed according to the PDO San Daniele rules to produce typical dry-cured hams (***weight and losses*** recorded)

statistical analysis

- data analysed (MIXED proc of SAS) according to a linear model which included the following effects:
  - batch (B)
  - diet (D)
  - B x D
  - pen within BxD (*random*): error line for B and D
  - gender (G)
  - genetic type (GT)
  - D x G
  - D x GT
- P values for differences between GT corrected for multiple testing using a Bonferroni correction

Results

effect of genetic type on growth performance

	genetic type			
	anas	danbred	goland	topigs
BW, kg:				
- initial	85.4^{a}	92.2^{b}	86.9^{a}	86.6^{a}
- final	163.3^{ab}	172.4^{c}	165.7^{b}	159.5^{a}
ADG, g/d	681^{ab}	701^{b}	689^{b}	637^{a}
Feed intake, kg/d	2.57	2.56	2.57	2.56
Gain/feed, kg/kg	0.265^{b}	0.273^{b}	0.268^{b}	0.248^{a}
Backf depth, mm				
- initial	10.00^{c}	8,33^{a}	9.20^{b}	8.56^{ab}
- final	19.41^{c}	15.94^{a}	17.61^{b}	16.30^{ab}
gain backft, mm	9.41^{b}	7.60^{a}	8.40^{ab}	7.75^{a}

effect of genetic type on carcass traits

	genetic types			
	anas	danbred	goland	topigs
carcass wt,kg	135^{b}	140^{b}	136^{b}	129^{a}
dressing perc, %	82.7^{b}	81.3^{a}	81.8^{ab}	80.8^{a}
backf thick, mm	32.3^{b}	29.5^{a}	29.7^{a}	28.3^{a}
commercial cuts weight, kg				
total lean	70.4^{ab}	76.3^{c}	72.0^{ab}	68.0^{a}
- raw ham	31.9^{b}	34.0^{c}	31.9^{b}	30.4^{a}
total fat, kg	35.2^{bc}	33.7^{ab}	34.7^{bc}	32.5^{a}
commercial cuts incidence, %				
total lean	52.3^{a}	54.5^{b}	53.2^{a}	52.9^{a}
- raw ham	23.6^{a}	24.2^{b}	23.6^{a}	23.6^{a}
total fat	26.1^{c}	24.0^{a}	25.6^{bc}	25.2^{b}

effect of genetic type on dressed ham (DH) traits (P < 0.05)

	genetic types			
	anas	danbred	goland	topigs
DH weight, kg	28,44^{b}	30,33^{c}	28,43^{b}	27,07^{a}
DH yield, %	21.07^{a}	21.56^{b}	21.00^{a}	21.01^{a}
visual appraisal, score (1 batch only, 96 pigs)				
- marbling	1.21^{a}	2.02^{b}	1.29^{a}	2.43^{b}
- lean colour	0.04^{b}	-0.97^{a}	0.08^{b}	0.32^{b}
- depot fat thick	0.58^{b}	-1,40^{a}	0.38^{b}	0.52^{b}
subcutaneous fat assessment:				
- thickness, mm	25.90^{b}	20.17^{a}	25.62^{b}	26.09^{b}
- iodine value	65.17^{a}	66.64^{b}	65.82^{ab}	66.79^{b}
Dry-curing loss,%	28.34^{a}	30.08^{b}	29.07^{ab}	29.29^{ab}

- effect of diet was less important
- pigs fed the LP diet showed (P<0.05):
  - slightly worse feed efficiency
  - lower weight and incidence of lean and higher of fat cuts

	diet	
	CONV	LP
Gain/feed, kg/kg	0.271[b]	0.255[a]
lean cuts, kg	73.13[b]	70.27[a]
fat cuts, kg	34.13[b]	33.94[a]

conclusions

- genetic type affected most growth performance, carcass and ham traits:

D: ↑ BW, ADG, carcass, lean cuts and ham weight
↓ incidence of fat cuts
↓ subcutaneous fat layer and dry-curing yield

T: ↓ carcass and ham weight
↑ marbling and Iodine value

A + G: - comparable carcass, cuts and ham weight
- comparable ham quality traits, closer to those required by PDO than D and T

- LP slightly affected feed efficiency and lean/fat cuts ratio, no influence on ham quality
- response to LP not different among GT

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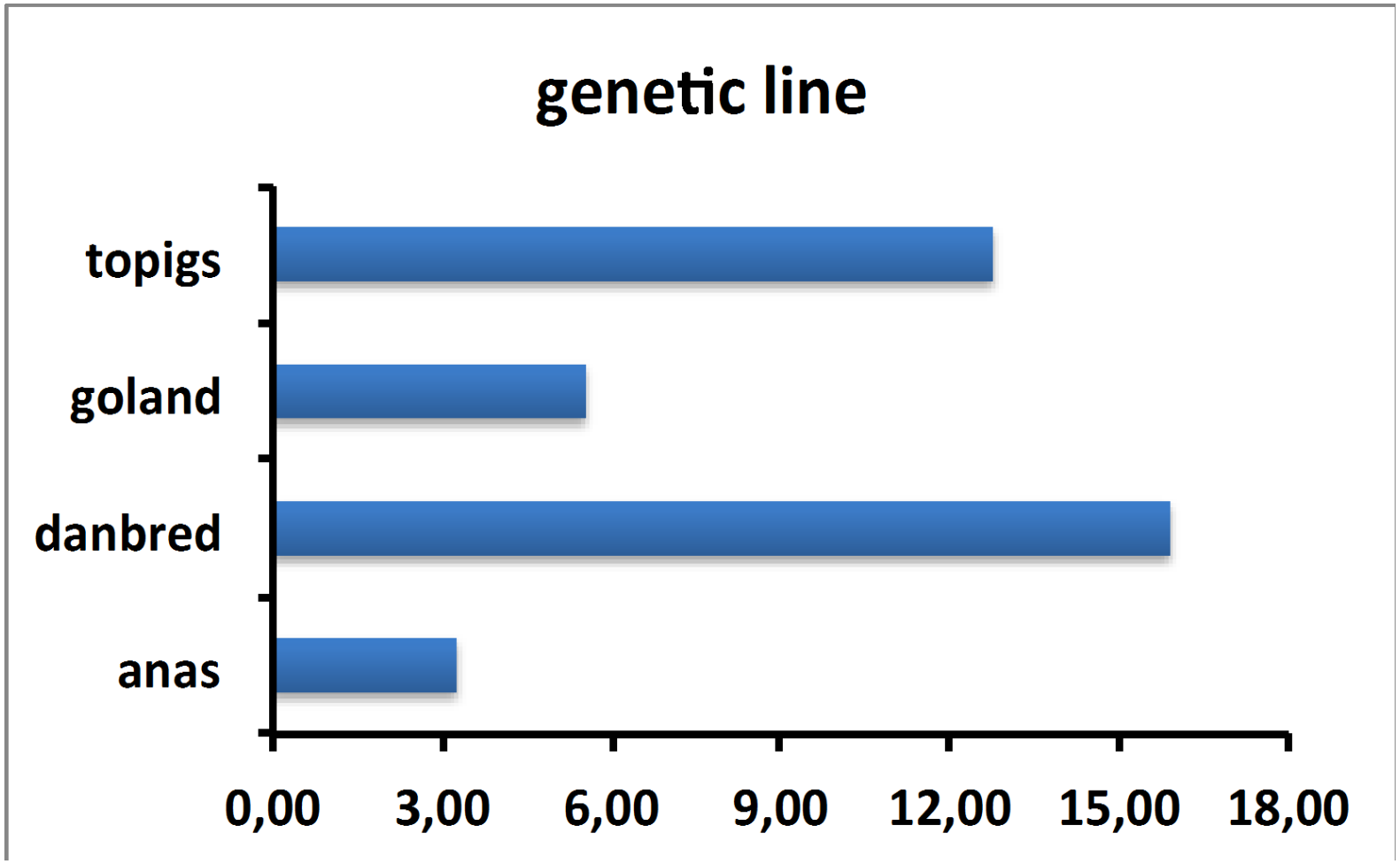
hams not approved for DPO label (%)



effect of genetic types on dry-cured (DC) ham traits (P < 0.05)

	genetic types			
	anas	danbred	goland	topigs
DC ham wt., kg:				
- initial	27.86 ^{b}	29.58^{c}	27.94^{b}	26.45^{a}
- after salting	26.87^{b}	28.50^{c}	26.98^{b}	25.52^{a}
- after resting	22.39^{b}	23.48^{c}	22.41^{b}	21.16^{a}
- end*	20,89^{c}	20,81^{bc}	19,86^{b}	18,77^{a}
yield of DC ham %				
- after salting	3,54	3,67	3,44	3,48
- after resting	19.68^{a}	20.65^{b}	19.78^{a}	20.00^{a}
- overall*	28.34^{a}	30.08^{b}	29.07^{ab}	29.29^{ab}

*One batch only (n. = 83 pigs)

effect of diet and gender on dressed ham (DH) traits ($P < 0.05$)

	diet		gender	
	CONV	LP	gilts	barr
DH weight, kg	29.02	28.12	28.69	28.45
DH yield, %	21.28	21.04	21.35[b]	20.97[a]
visual appraisal, score (one batch only, 96 pigs)				
- round shape	1.44	1.02	1.34	1.12
- marbling	1.62	1.86	1.57[a]	1.90[b]
- lean colour	0.00	- 0.26	- 0.44[a]	0.18[b]
- depot fat thick	- 0.05	0.09	- 0.34[a]	0.38[b]
subcutaneous fat assessment:				
- thickness, mm	24.29	24.60	24.17	24.72
- iodine value	66.29	65.91	66.48[b]	65.71[a]

effect of diet and gender on dry-cured (DC) ham traits ($P < 0.05$)

	diet		gender	
	CONV	LP	gilts	barr
ham weight, kg:				
- initial	28.37	27.54	28.13	27.78
- after salting	27.37	26.56	27.15	26.78
- after resting	22.68	22.05	22.52	22.21
- end*	20.06	20.10	20.17	20.00
yield of ham, %:				
- after salting	3.52	3.54	3.51	3.56
- after resting	20.06	20.00	20.02	20.04
- overall*	29.57	28.82	29.32	29.08

*One batch only (n. = 83 pigs)