



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Productive performance and nitrogen excretion of fast-, medium- and slow-growing chicken genotypes fed diets varying in protein-to-energy ratio

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Introduction

The use of slower-growing chicken genotypes for meat production is expected to increase substantially in the next decades due to:

- Animal welfare concerns
- Product quality issues

Slower-growing chicken genotypes:

- High welfare standards
- Better meat quality traits
- Low productive performance, feed efficiency and meat yield
- Limited knowledge about nutrient requirements and nutritional strategies to optimize productive and sustainability traits



From Hubbard website



From Aviagen website



Aim of the study

To evaluate the **productive performance** and **nitrogen excretion** of **chicken genotypes characterized by different growth rate**

- Fast-growing (**FG**; >70 g/bird/d)
- Medium-growing (**MG**; 40-50 g/bird/d)
- Slow-growing (**SG**; 30-40 g/bird/d)

when **fed** either:

- **Conventional basal diet (CON)** - formulated to meet FG broilers requirements
- **CON diet with reduced crude protein-to-metabolizable energy ratio (-10% protein; LOW)** - representative of commercial diets used for slower-growing chickens

Materials and Methods

Experimental design

1,800 one-day-old male chicks
(600 for each genotype)



		<i>Genotype</i>		
		<i>FG</i>	<i>MG</i>	<i>SG</i>
<i>Diet</i>	<i>CON</i>	FG-CON	MG-CON	SG-CON
	<i>LOW</i>	FG-LOW	MG-LOW	SG-LOW

- Each experimental group was composed by **6 replicate pens of 50 birds each** (i.e., 300 broilers/group)
- **Growth performance** parameters were recorded at the **end of each feeding phase** (0, 13, 28 and slaughter age)
- At slaughtering (34, 50 and 77 days for FG, MG and SG, respectively), broilers were **individually weighed** to evaluate **body weight uniformity**
- Broilers were then processed in a commercial processing plant to assess **slaughter yields** and **occurrence of footpad dermatitis**



Materials and Methods

Diets

	Starter (0-13 d)		Grower (14-27 d)		Finisher (28 d – slaughter)	
Ingredients (%)	CON	LOW	CON	LOW	CON	LOW
Corn	29.19	35.89	32.48	39.13	39.23	45.41
Wheat	25.00	25.00	25.00	25.00	25.00	25.00
Soybean meal	17.49	15.87	17.65	15.85	16.33	14.93
Full-fat soybean	10.72	5.47	13.65	8.63	8.63	3.97
Pea	3.00	3.00	3.00	3.00	3.00	3.00
Sunflower meal	3.00	3.00	3.00	3.00	3.00	3.00
Corn gluten meal	3.00	3.00	0.00	0.00	0.00	0.00
Vegetable oil	1.51	1.51	1.75	1.75	2.00	2.00
Others	7.09	7.26	3.47	3.64	2.81	2.69
Chemical composition						
AMEn (kcal/kg)	3.016	3.016	3.070	3.070	3.100	3.101
Crude protein (%)	22.50	20.34	20.51	18.29	18.50	16.51
Lipids (%)	5.43	4.62	6.11	5.38	5.55	4.84
Ashes (%)	4.86	4.67	4.42	4.27	4.02	3.82
Av. Lys (%)	1.25	1.15	1.15	1.04	1.02	0.90
Av. Met+Cys/Av. Lys	0.75	0.74	0.77	0.77	0.80	0.80
Av. Arg/Av. Lys	1.07	1.06	1.11	1.09	1.12	1.10
Total calcium (%)	0.68	0.68	0.58	0.58	0.54	0.52
Total phosphorous (%)	0.54	0.54	0.44	0.43	0.37	0.35

Feed administered *ad-libitum* and in pellet form



Materials and Methods

Nitrogen excretion

$$N \text{ excreted} = N \text{ input from feed} - N \text{ retained in the body}$$

$\sum \text{Feed intake phase} \times N \text{ content feed}$

Whole-body N content at slaughter age

6 birds/group
(1 bird/replicate pen)



humanely
euthanized
(CO₂ method)



whole body frozen in liquid
nitrogen and grinded to
obtain homogenous
samples



N content
determination
through Kjeldahl
method



Results

Growth performance in the overall rearing cycle (FG: 0-34 days; MG = 0-50 days; SG = 0-77 days)

Trait	Group						Genotype (G)			Diet (D)		SEM	P-value		
	FG-CON	FG-LOW	MG-CON	MG-LOW	SG-CON	SG-LOW	FG	MG	SG	CON	LOW		GxD	G	D
DWG (g/bird/d) [§]	69.6	66.9	52.9	50.8	37.0	36.9	68.3 A	51.9 B	37.0 C	53.2	51.5	2.18	0.06	<0.001	<0.001
Final BW (g/bird)	2482 d	2375 e	2686 b	2581 c	2891 a	2877 a	2429 C	2633 B	2884 A	2686	2611	33.2	0.04	<0.001	<0.001
DFI (g/bird/d) [§]	100.2	99.2	94.6	93.1	99.2	98.6	99.7 A	93.9 B	98.9 A	98.0	97.0	0.54	0.86	<0.001	0.10
FCR [§]	1.440 e	1.482 d	1.790 c	1.833 b	2.679 a	2.673 a	1.461 C	1.811 B	2.676 A	1.969	1.996	0.09	0.02	<0.001	<0.01
Mortality [†] (%)	1.33	2.00	1.00	1.65	0.67	1.00	1.67	1.33	0.83	1.00	1.55	0.01	0.96	0.42	0.29

§ Corrected for mortality.

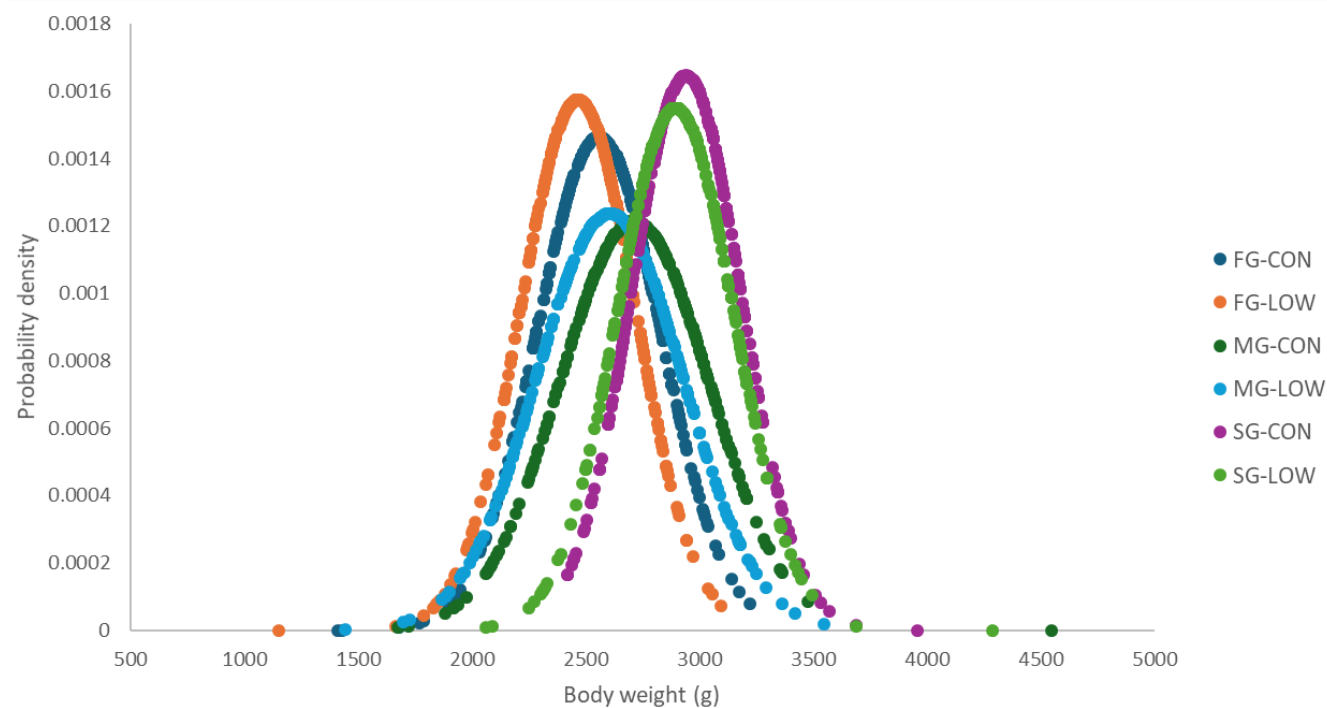
Means showing different letters are significantly different (A,B: P<0.01; a,b: P<0.05).

DWG, daily weight gain; BW, body weight; DFI, daily feed intake; FCR, feed conversion ratio; SEM, standard error of the mean.



Results

Body weight uniformity at slaughtering



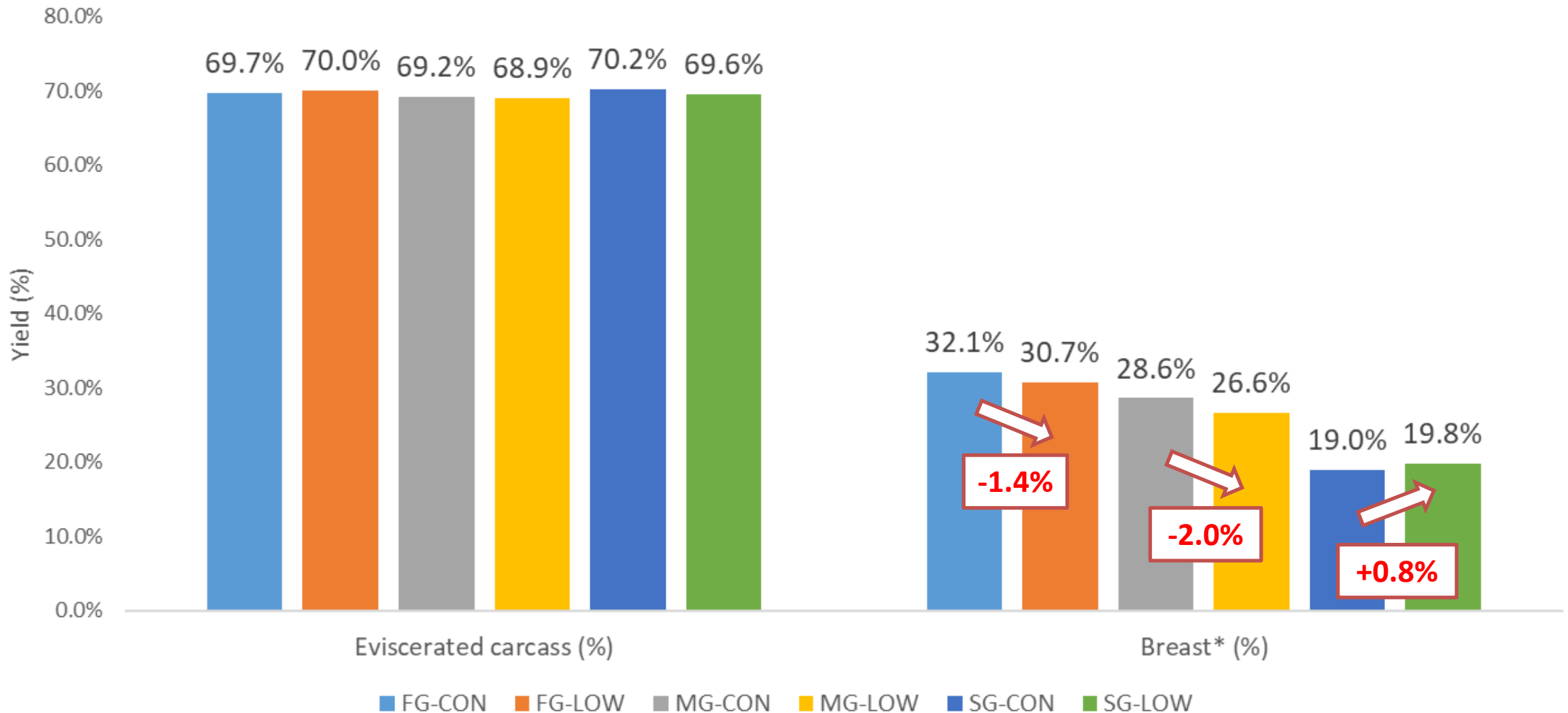
Group	CV (%)
FG-CON	10.7%
FG-LOW	10.3%
MG-CON	12.1%
MG-LOW	12.4%
SG-CON	8.2%
SG-LOW	8.9%

Factor	Comparison	P-value
Genotype	FG vs. MG	P<0.001
	FG vs. SG	P<0.0001
	MG vs. SG	P<0.0001
Diet	CON vs. LOW	0.11



Results

Slaughter yields (on all processed birds on a group basis)

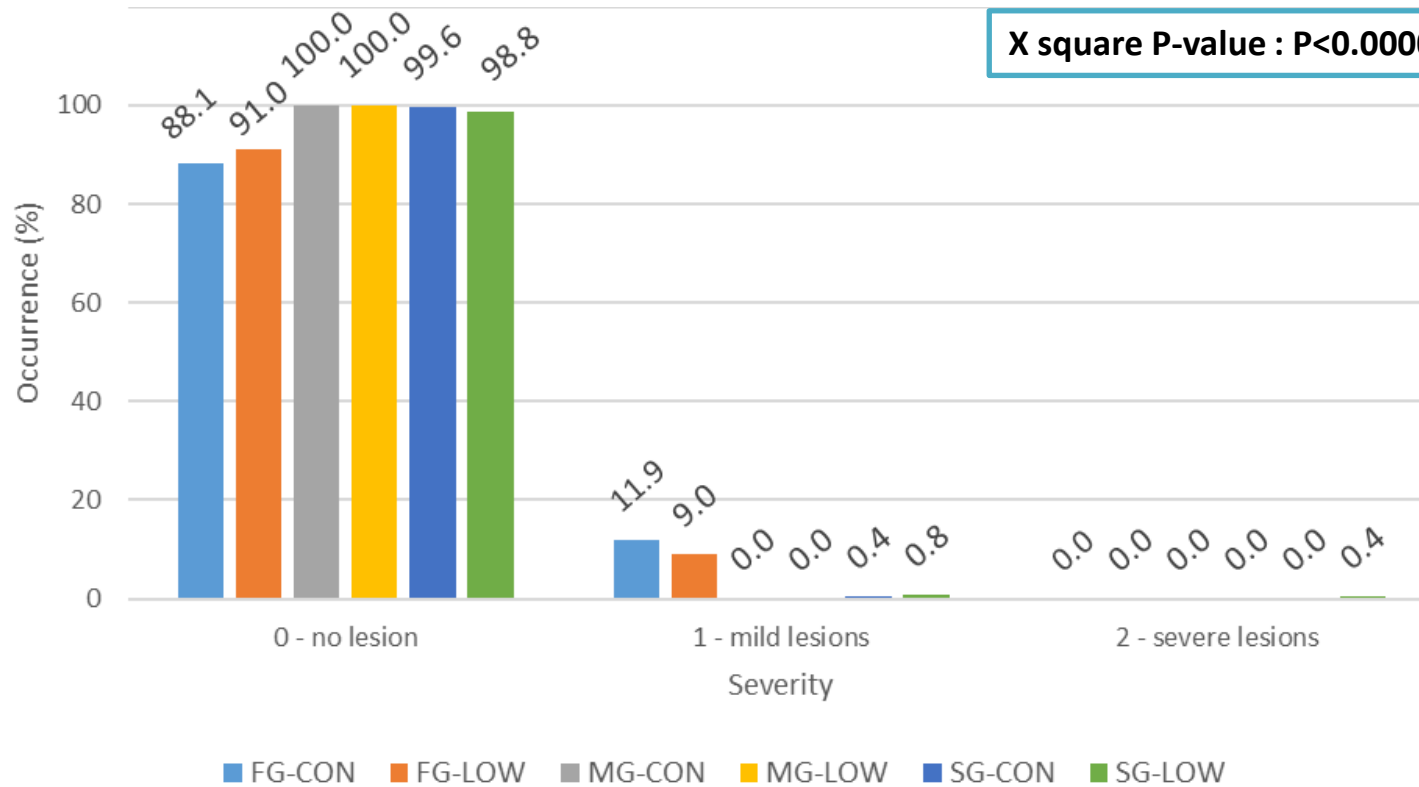


n processed birds = 272, 276, 273, 278, 274, 279, respectively for FG-CON, FG-LOW, MG-CON, MG-LOW, SG-CON and SG-LOW

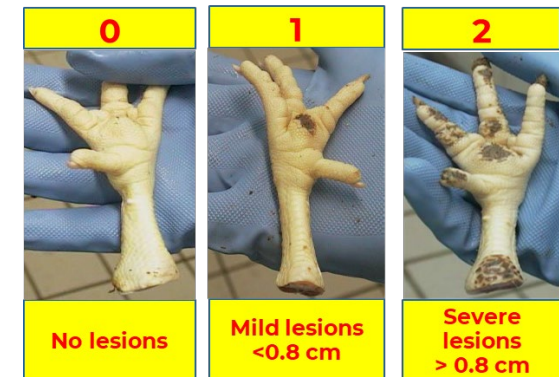
* Expressed as % of eviscerated carcass weight

Results

Occurrence of footpad dermatitis at slaughtering



Factor	Comparison	P-value
Genotype	FG vs. MG vs. SG	$P < 0.00001$
Diet	CON vs. LOW	0.41

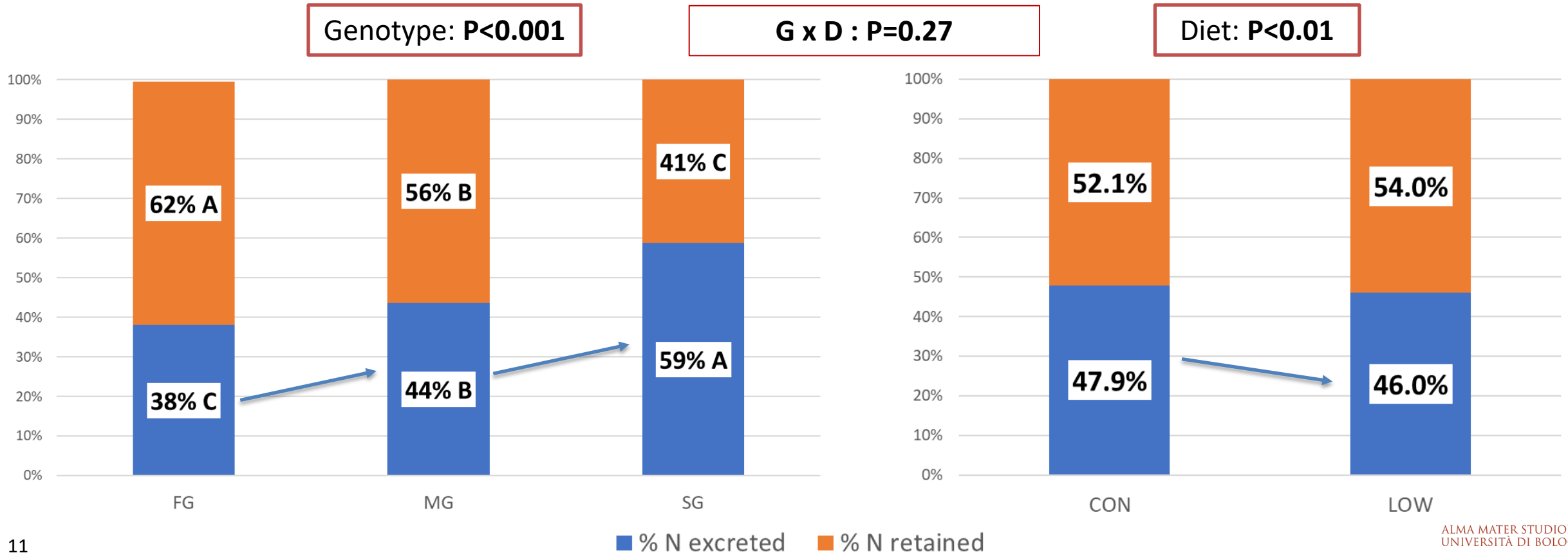


Results

Nitrogen excretion (g/kg BWG)

N excretion (g/kg BWG)	Group						Genotype (G)			Diet (D)		SEM	GxD	P-value	
	FG-CON	FG-LOW	MG-CON	MG-LOW	SG-CON	SG-LOW	FG	MG	SG	CON	LOW			G	D
	17.5 E	15.8 F	24.1 C	21.3 D	46.5 A	42.6 B	16.7 C	22.7 B	44.5 A	29.4	26.6	2.04	0.02	<0.001	<0.001

N excreted/N retained



Conclusions

- The **reduction of the protein-to-energy ratio worsened the growth performance of FG and MG chickens**, while had **no relevant effects on productive traits of the SG strain**
- **Body weight uniformity** was influenced by the chicken genotype, with the **worst uniformity** observed in the **MG group** and the **best** in the **SG group**
- The **occurrence of footpad dermatitis was very limited**, even though **FG birds** showed a **higher propensity to develop these lesions**
- **Nitrogen excretion** was significantly influenced by both genotype and diet, with **SG birds fed the CON diet** showing the **highest excretion per kg of weight gain**. The **N excreted-to-N retained ratio** was significantly affected by both factors

Increasing the dietary protein content do not seem to be a valid strategy to improve productive performance and efficiency of SG chickens, while also determined higher N excretion.

In FG and MG chickens, the reduction of the crude protein content improved N excretion but had detrimental effects on growth performance

Acknowledgments

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Thanks for your attention!





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