



# Dietary L-arginine supplementation enhances growth performance, intestinal antioxidant capacity, immunity and modulates gut microbiota in yellow-feathered chickens

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## Introduction

Arginine (Arg) is an essential amino acid and is also a functional amino acid. It is an important substrate for protein synthesis and a precursor of many molecules. Arg and/or its metabolites enhance growth performance, reproduction, digestive enzymes secretion, nutrient transporters, antioxidant status, intestinal barrier, and immunity. The Arg requirements for modern strains of broiler chickens showed that its requirements of Arg depending on age, sex and other variables. These studies mentioned above have shown that Arg requirements vary greatly among species. To date, very little is known about the Arg requirements of Chinese yellow feathered broiler chickens.

## Results

The average daily feed intake, average daily gain, and feed conversion ratio were improved with dietary Arg levels ( $P < 0.05$ ). Dietary Arg level had a linear ( $P < 0.05$ ) or quadratic ( $P < 0.05$ ) effect on the gene expression of glutathione peroxidase 1, heme oxygenase 1, nuclear factor erythroid 2-related factor 2, and the activities of glutathione peroxidase and total antioxidant capacity in the jejunum and ileum. The relative expression of interleukin-1 $\beta$  and toll-like receptor 4 decreased linearly ( $P < 0.05$ ) and quadratically ( $P < 0.05$ ) in the ileum with increasing dietary Arg levels; secretory immunoglobulin A contents were increased. In addition, sequencing data of 16S rRNA indicated that dietary Arg increased the abundances of Firmicutes phylum, *Romboutsia* and *Candidatus Arthromitus* genera, while decreased that of *Clostridium sensu stricto 1*.

Table 1. Effects of the dietary L-arginine level on the antioxidant indices in jejunum and ileum of yellow-feathered chickens at 30 days of age

Indices <sup>2</sup>	Dietary Arg level, g/kg					SEM	P-value		
	8.5	9.7	10.9	12.1	13.3		Arg	Linear	Quadratic
Jejunum									
GSH-PX (U/mg prot)	4.81 <sup>b</sup>	6.32 <sup>b</sup>	11.36 <sup>a</sup>	11.88 <sup>a</sup>	7.55 <sup>a,b</sup>	1.329	<0.001	0.016	0.004
T-SOD (U/mg prot)	743.2	764.9	735.1	749.9	765.9	71.46	NS	NS	NS
T-AOC (U/mg prot)	1.73 <sup>b</sup>	1.87 <sup>b</sup>	1.95 <sup>a,b</sup>	2.11 <sup>a</sup>	2.08 <sup>a</sup>	0.099	0.074	0.008	0.061
MDA (nmol/mg prot)	0.595 <sup>a</sup>	0.353 <sup>a,b</sup>	0.349 <sup>a,b</sup>	0.297 <sup>b</sup>	0.281 <sup>b</sup>	0.071	0.0264	0.067	NS
Ileum									
GSH-Px (U/mg prot)	7.18 <sup>c</sup>	13.85 <sup>b,c</sup>	22.32 <sup>a,b</sup>	26.85 <sup>a</sup>	16.76 <sup>b</sup>	2.48	<0.001	<0.001	0.004
T-SOD (U/mg prot)	754.5	684.6	793.1	705	731.3	79.08	NS	NS	NS
T-AOC (U/mg prot)	1.99 <sup>b</sup>	2.20 <sup>a,b</sup>	2.19 <sup>a,b</sup>	2.66 <sup>a</sup>	2.24 <sup>a,b</sup>	0.138	0.022	0.019	0.035
MDA (nmol/mg prot)	0.223	0.197	0.181	0.172	0.225	0.035	NS	NS	NS

Table 2. Effects of the dietary L-arginine level on the immunological indices in jejunum and ileum of yellow-feathered chickens at 30 days of age

Indices <sup>2</sup>	Dietary Arg level, g/kg					SEM <sup>3</sup>	P-value <sup>4</sup>		
	8.5	9.7	10.9	12.1	13.3		Arg	Linear	Quadratic
Jejunum									
IgG (µg/mg prot)	18.97 <sup>b</sup>	20.43 <sup>a,b</sup>	21.62 <sup>a,b</sup>	26.24 <sup>a</sup>	28.20 <sup>a</sup>	2.338	0.057	0.013	NS
IgM (µg/mg prot)	3.59	5.06	5.07	5.36	5.95	0.982	NS	NS	NS
SIgA (µg/mg prot)	2.05	2.47	2.35	2.63	1.92	0.518	NS	NS	NS
Ileum									
IgG (µg/mg prot)	19.58	17.54	21.33	21.74	22.79	1.891	NS	NS	NS
IgM (µg/mg prot)	3.87	3.12	3.68	4.04	4.57	0.425	NS	NS	NS
SIgA (µg/mg prot)	1.06 <sup>b</sup>	1.29 <sup>a,b</sup>	1.76 <sup>a</sup>	1.99 <sup>a</sup>	1.78 <sup>a</sup>	0.235	0.034	0.011	0.047

## Conclusions

The present study with *Qingyuan* partridge chickens demonstrated that growth performance was improved by increasing dietary Arg from 8.5 to approximately 12 g/kg. The optimal Arg levels for maximizing ADG, FCR, ileal activity of GSH-Px and content of sIgA were 12.2, 11.0, 11.0, and 11.9 g/kg, respectively. Dietary Arg enhanced intestinal antioxidant capacity and immune function and improved the population structure of gut microbiota, favoring intestinal health.

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## Materials &methods

A total of 1,200 Qingyuan female hachtings were randomly assigned to 5 groups with 6 replicates of 40 birds each. Chickens were fed diets with 5 levels of total Arg (8.5, 9.7, 10.9, 12.1 and 13.3 g/kg). All chicks were handled in accordance with the *Qingyuan* partridge chicken management guidelines for lighting, *ad libitum* feeding and allowed access to non-antibiotic tap water from 1 to 30 days.

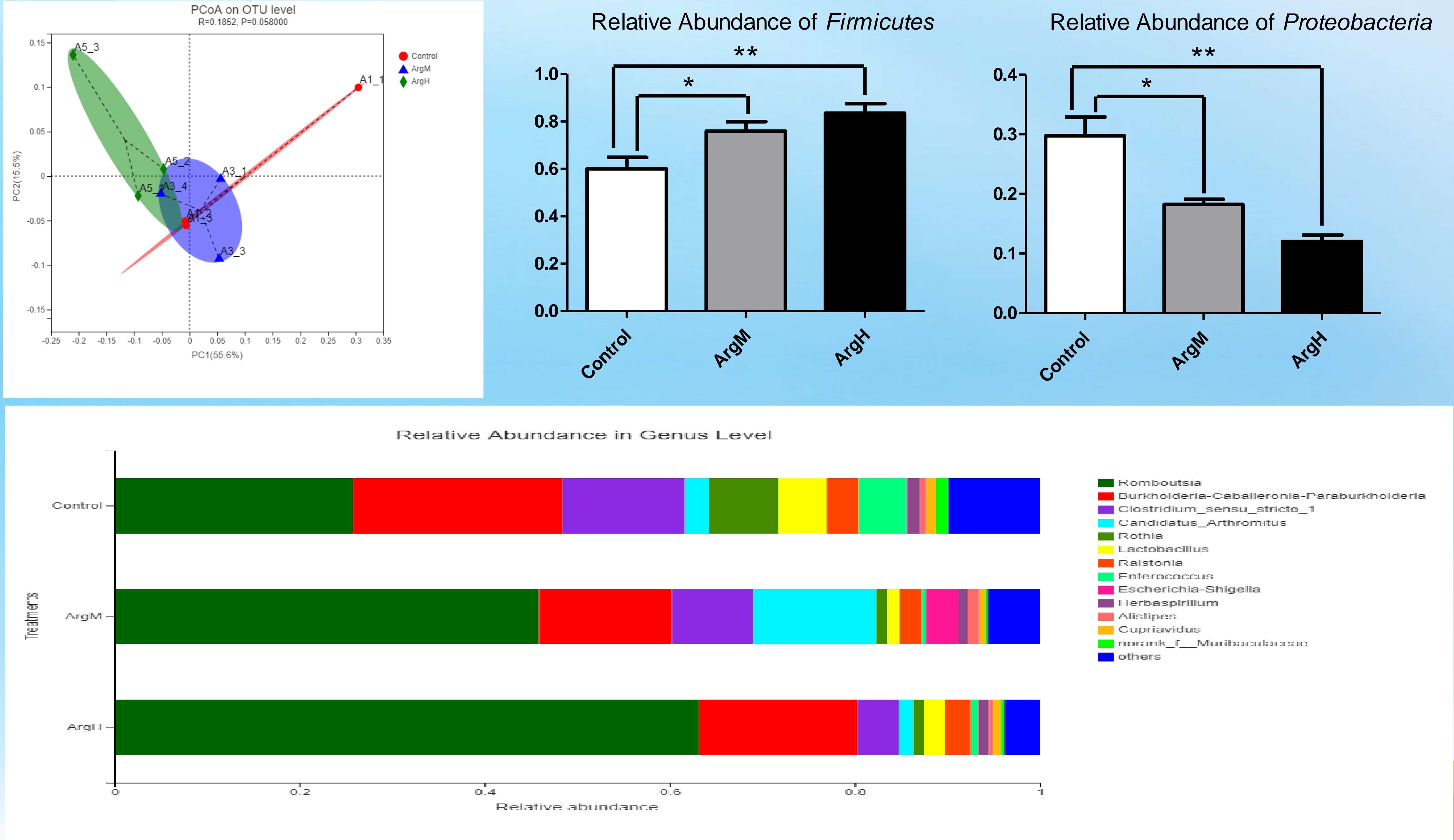


Fig 1. Effect of arginine on microbiome composition in the ileum of yellow-feathered chickens.