PPILOW

Conversion efficiency of the main bioactive compounds (PUFA, tocols, carotenoids) in different commercial slow-growing chicken genotypes extensively reared

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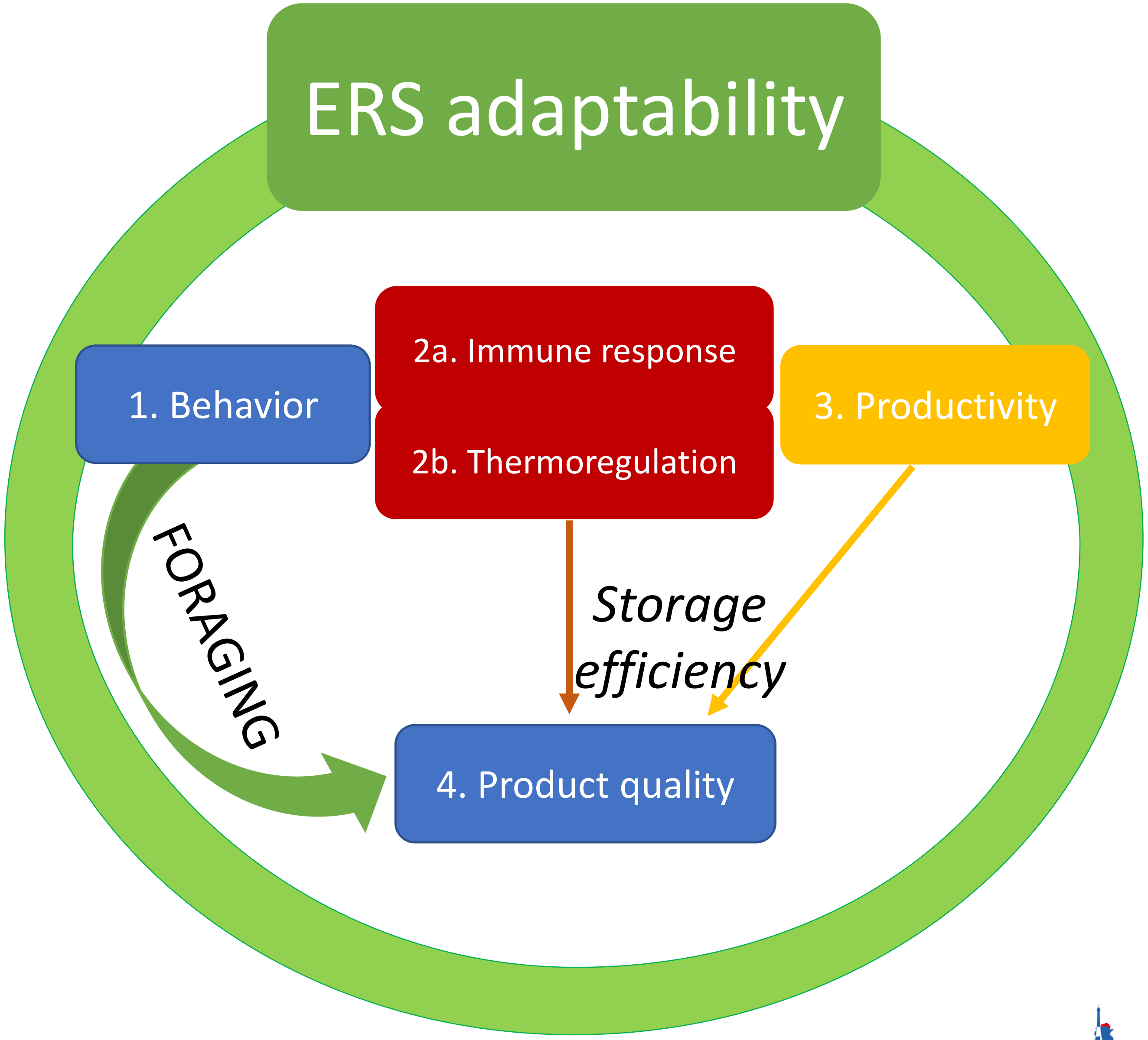
ERS must **optimize a production system that promotes biodiversity, environmental sustainability and food safety** (*National Organic Standards Board, 1995)*



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Resource allocation theory

Dietary inputs

	FG	SG
MANTEINANCE kinetic activity, foraging behaviour, reproduction, immune response, thermo-tolerance	50%	70%
PRODUCTION muscle growth, deposition rate of dietary resources	50%	30%

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Assess the storage efficiency of bioactive compounds (n-3 and n-6 PUFA, tocols and carotenes) on meat of seven commercial slow-growing genotypes.

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PPILOW Material and Methods – Genotypes

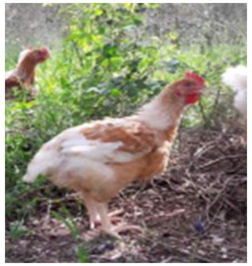
100 chickens/genotype (Aviagen/ Hubbard)
25 chickens x 4 replicates
both sexes (male:female, 1:1)

SG1

SG2

SG3

SG4



SG5

SG6

SG7

	SG1	SG2	SG3	SG4	SG5	SG6	SG7
DWG (g/d/bird)	**32.11**	**32.50**	**34.91**	**41.90**	**42.36**	**44.83**	**48.87**
	Walking (W) chickens				Not-Walking (NW) chickens		

by Cartoni Mancinelli et al. (2021); by Pulcini et al. (2021)

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PPILOW Material and Methods – Animal husbandry

Each strain was reared in **4 different pens** (128 m^2 of outdoor space replicates).

- indoor (0.10 m^2/bird) and outdoor (4 m^2/bird) densities of animals (EC Regulation nos. 834/2007 and 889/2008);
- the animals were fed *ad libitum* with the same diet, water was always available, and the birds were kept in shelters only during the night to protect them from predators.

0 — starter feed — 21 — grower feed — 81

environmentally controlled poultry house
(T° 30±2°C, RU 65±3%)

free access to the outdoor space
T° 19±7 °C
RU 50.1±12.5%

GRASS

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PPILOW Material and Methods - Diets

FEED INTAKE

2 period diets (1st 24.01% protein; 2nd 18.41% protein)

GRASS INTAKE

The grass intake was estimated by the exclusion pens method (Lantinga et al., 2004)

$$GI = (GMs - GMe) + \{[1 - (GMe/GMs]/-\ln[GMe/GMs]\} \times (GMu - GMs)$$

GM*s*= herbage mass present at the entrance of birds in each pen
GM*e*= forage that remained at the end of the trial
GM*u*= undisturbed forage mass from the exclusion pens



		Starter	Finisher	Grass
Ingredients				
Maize	%	53.92	53.11	
Soybean meal	"	30.23	15.69	
Wheat	"	5.00	15.00	
Maize meal	"	5.08	11.45	
Gluten feed	"	1.00		
Soybean oil	"	0.62	1.15	
Vitamin-mineral premix [a]	"	0.40	0.40	
Dicalcium phosphate	"	1.71	1.21	
Calcium carbonate	"	1.23	1.29	
NaCl	"	0.20	0.23	
Sodium bicarbonate	"	0.15	0.15	
Proximate composition				
Moisture	% of DM	12.20	12.00	78.61
Crude protein	"	24.01	18.41	8.34
Ether extract	"	3.99	4.55	2.11
Ash	"	6.92	5.78	7.85
Crude fibre	"	3.48	3.60	23.2
NDF	"	17.63	10.1	60.90
ADF	"	7.41	5.06	39.81
ADL	"	1.67	1.11	5.81
Cellulose	"	5.74	3.56	34.0
Hemicellulose	"	10.22	5.05	21.09
Metabolizable energy [b]	kcal/kg	3245.20	3295.94	3214.00
Bioactive compounds				
Vitamin A	mg/kg of D.M.	14.3	14.55	-
Vitamin E	"	67.5	55.03	355.51
Carotenes	"	2.16	3.65	401.65
SFA	"	0.99	1.06	6.05
MUFA	"	1.61	1.66	7.74
PUFA	"	3.79	3.87	16.72
n-6	"	3.52	3.58	8.16
n-3	"	0.27	0.29	8.56
n-6/n-3	-	13.04	12.34	0.95

[a] Amount per kg: vitamin A, 11,000 IU; vitamin D_3, 2000 IU; vitamin B_1, 2.5 mg; vitamin B_2, 4 mg; vitamin B_6, 1.25 mg; vitamin B_{12}, 0.01 mg; α-tocopheryl acetate, 30 mg; biotin, 0.06 mg; vitamin K, 2.5 mg; niacin, 15 mg; folic acid, 0.30 mg; pantothenic acid, 10 mg; choline chloride, 600 mg; manganese, 60 mg; iron, 50 mg; zinc, 15 mg; iodine, 0.5 mg; and cobalt, 0.5 mg.

[b] Estimated by Carrè and Rozo [19].

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PPILOW Material and Methods - Analytical evaluations

- ✓ At 81 days 10 animals / genotype were slaughtered
- ✓ Bioactive compounds of **pasture, feed and meat** were determined:
  - Vitamin E isoforms: α-, β+γ- and δ-tocopherols (HPLC/FLD)
  - Carotenes: lutein, zeaxanthin and retinol (Vitamin A) (HPLC/UV)

Estimation of storage efficiency

$$\text{OUT/IN} = \frac{\text{(Bioactive compound on breast, drumstick and leg)}}{[(\text{daily intake of compounds by grass X 59}) + (\text{daily intake of compounds by feed X 80})]}$$

- The sum of **breast**, **thing** and **drumstick** meat was choosen because represents
  more than 60% of chicken muscle mass
  more than 80% of commercial meat cuts
- The animals had **access to the outdoors for 59 days**;
- The entire rearing period (**chickens life**) lasted **80 days** (81 days-1 day of fasting).

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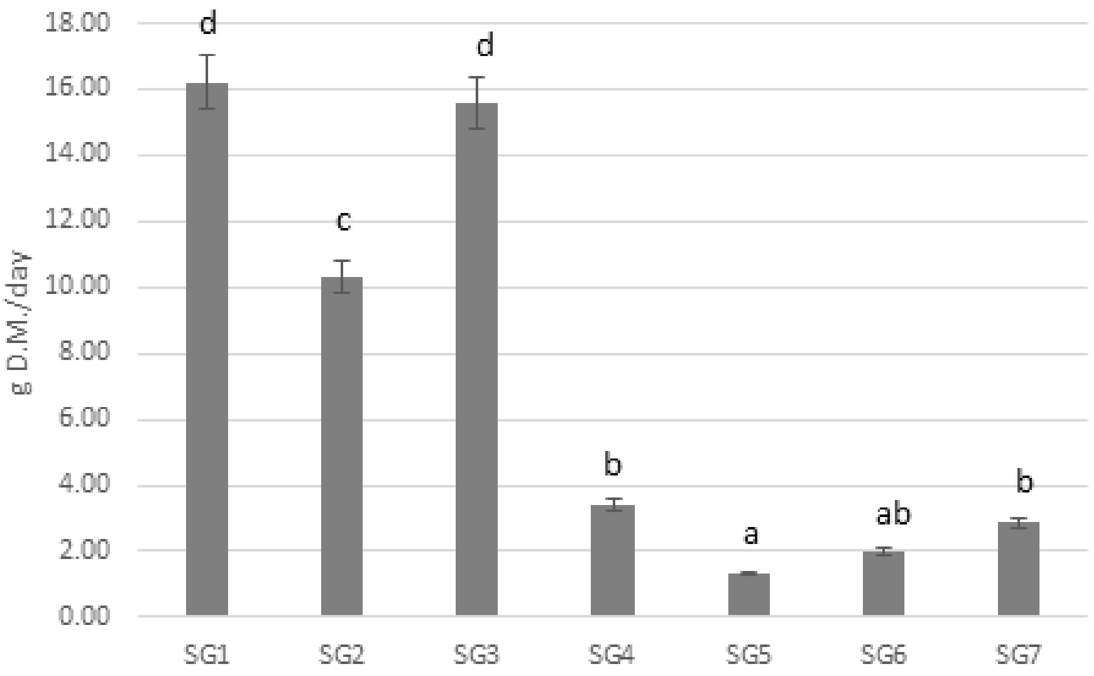
Walking chickens, showed also a higher grass intake

Figure 1. Estimated grass intake (g D.M./day, mean ± se) of different chicken genotypes along the trial



SG1, SG2, SG3, SG4: Walking chickens
SG5, SG6, SG7: Not-Walking chickens

a..d means P < 0.01.

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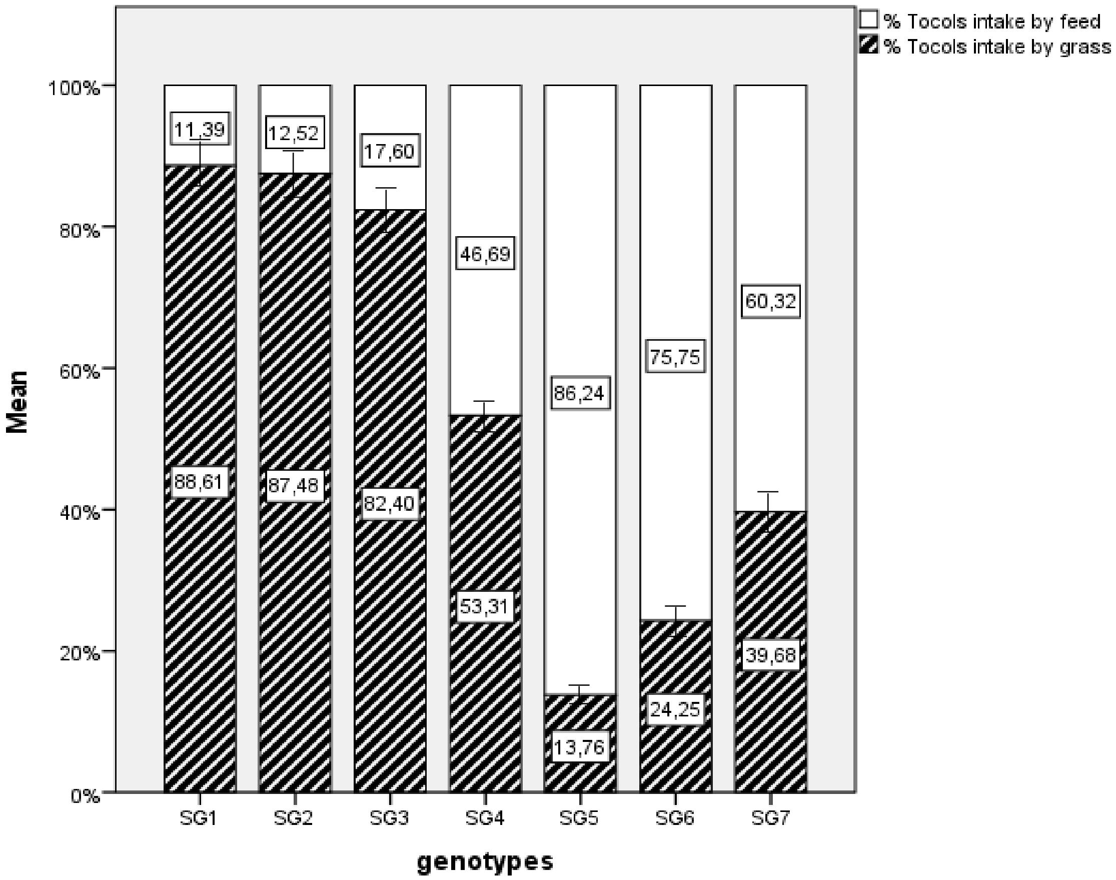
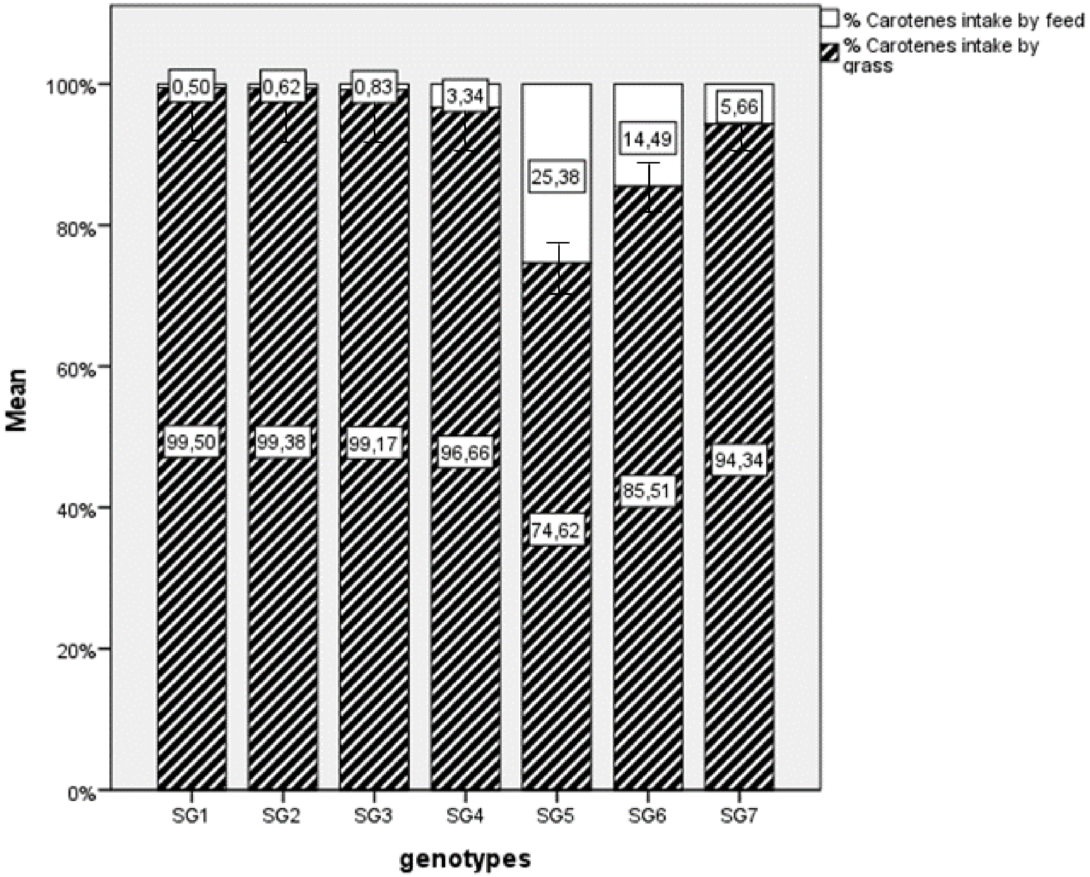
PPILOW Results- Bioactive compounds intake

Figure 2. Proportion (%) of tocols and carotenoids furnished by feed (white bar) and grass (black bar) intake.





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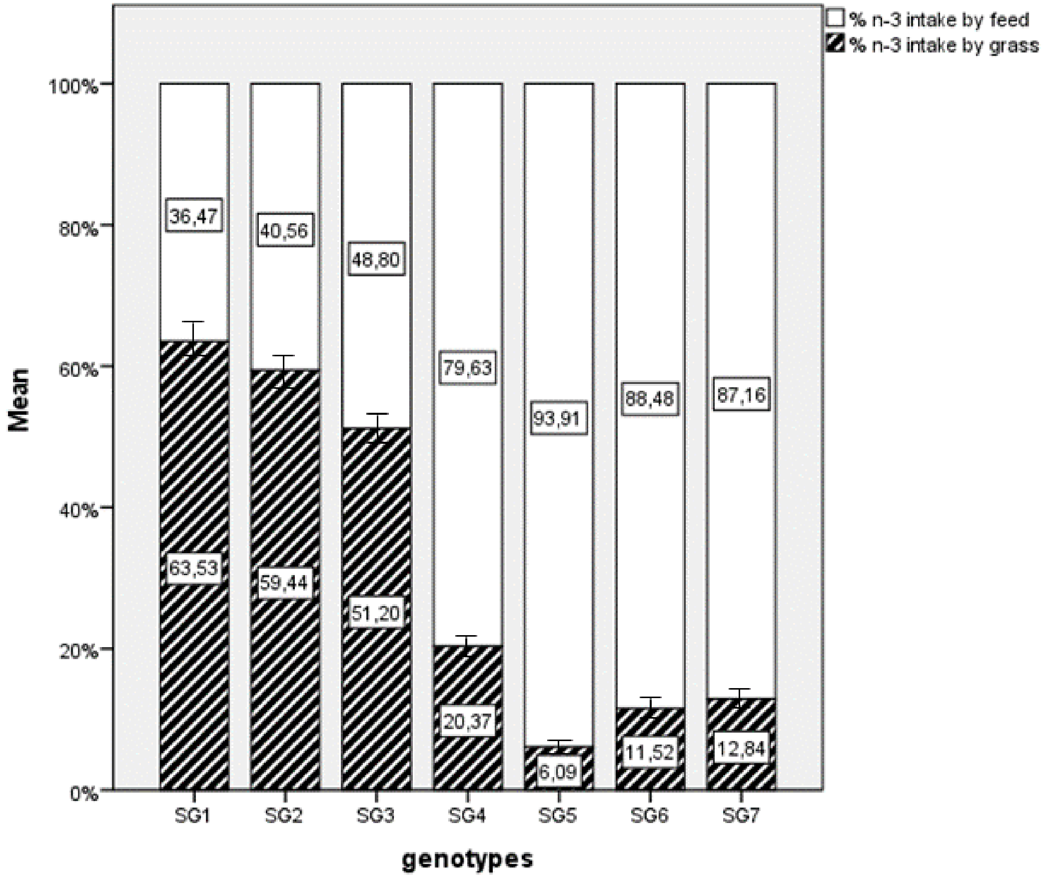
PPILOW Results- Bioactive compounds intake

Figure 3. Proportion (%) of n-3 PUFA and n-6 PUFA furnished by feed (white bar) and grass (black bar) intake.



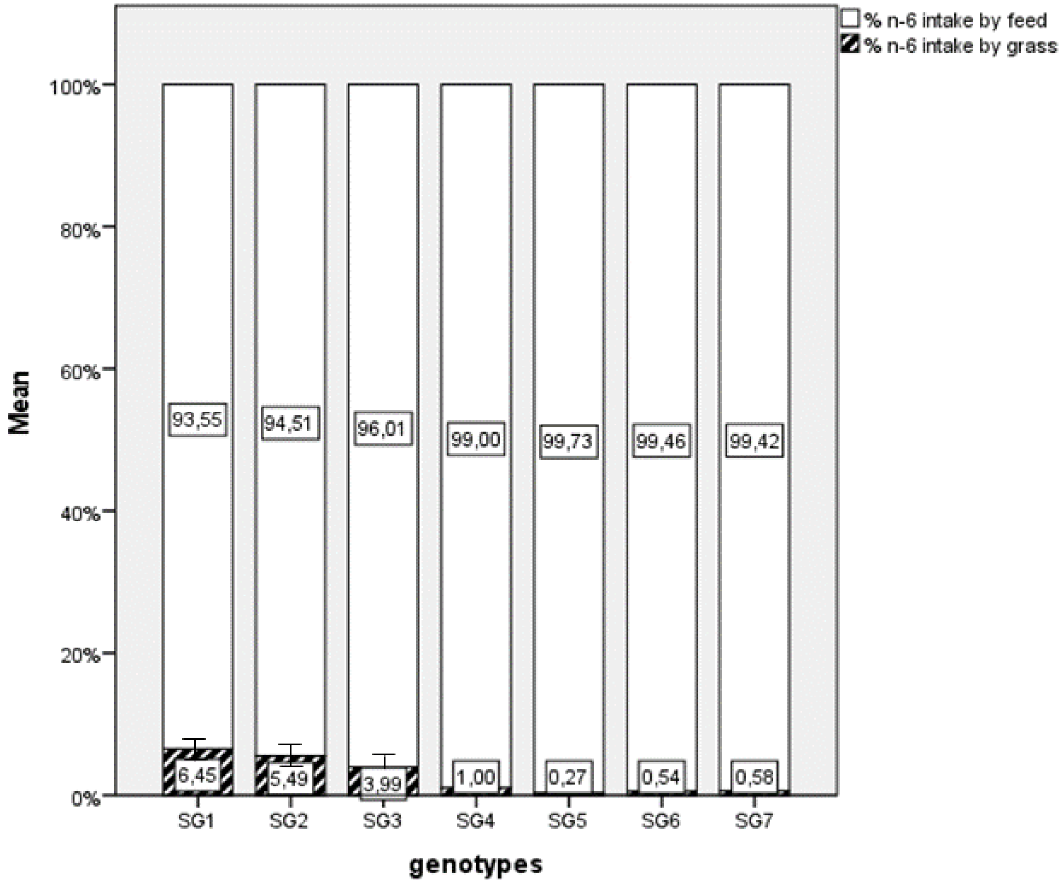


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Figure 4. **Grass** (g/d; green dot and line) and **n-3** (g/life, blue triangle and line) intake and **storage efficiency** (OUT/IN; red square and line), in relation to the foraging behaviors (%) of chicken genotypes.

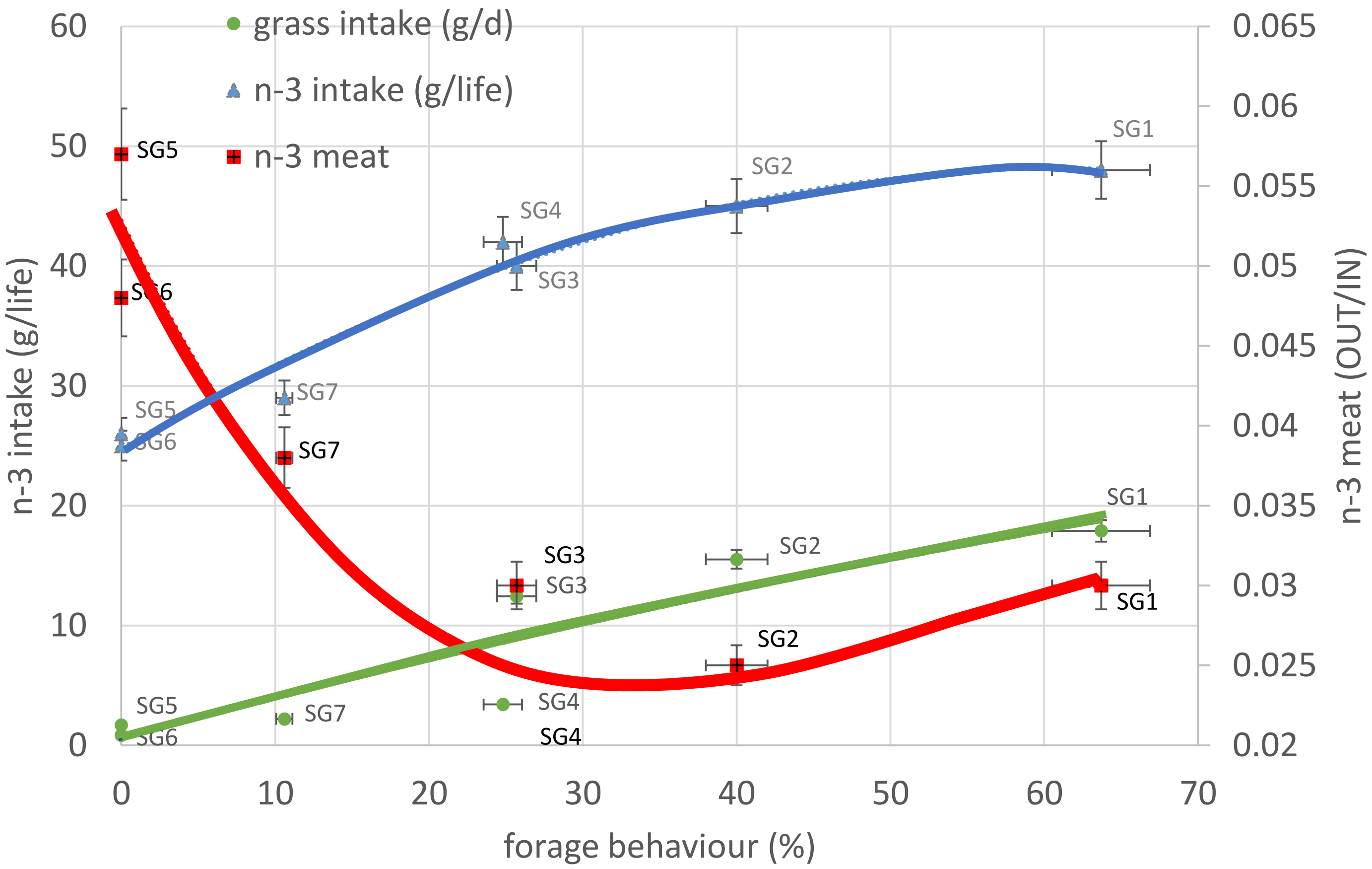

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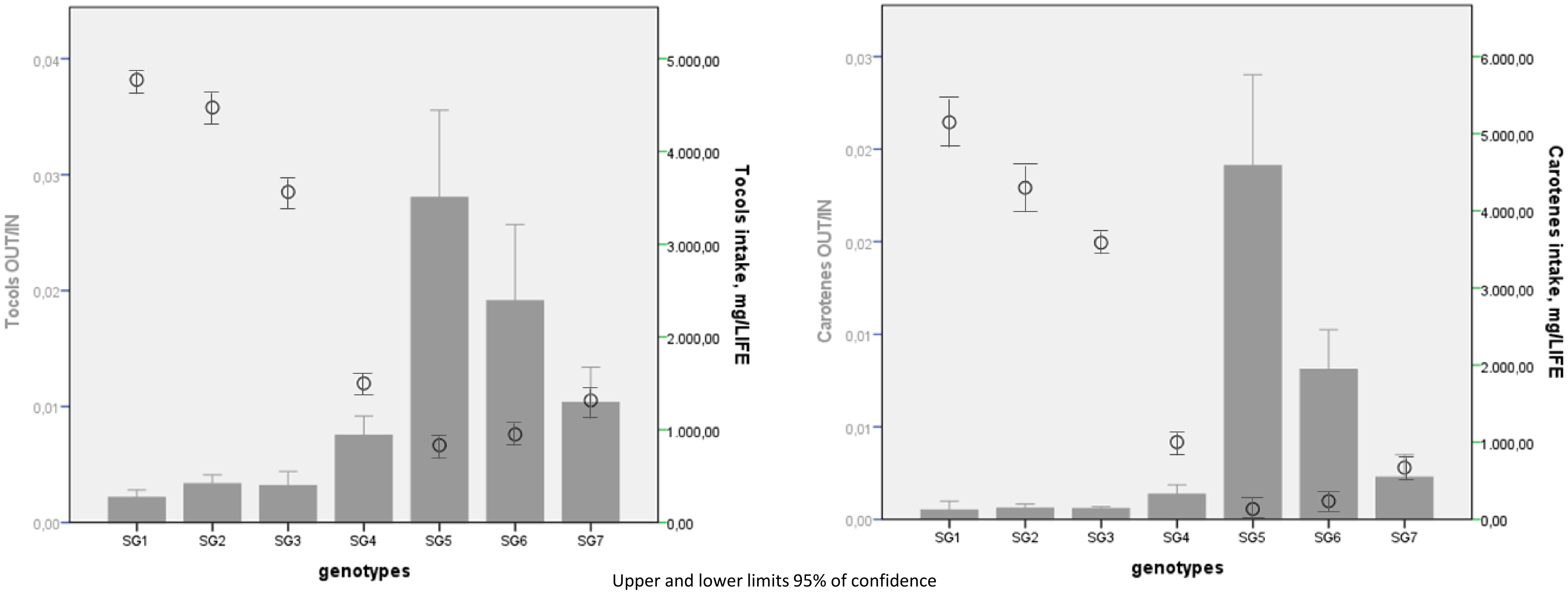
Figure 5. Storage efficiency (OUT/IN; grey full bar) into chicken body and tocols and carotenes intake (mg/life; black empty dot).



Upper and lower limits 95% of confidence

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PPILOW Conclusion

- **Pasture availability** is essential in ERS;
- Grass intake does not ensure energy and protein requirements;
- **Foraging** is relevant for the intake of bioactive compound (W chickens) because it provides a high share of molecules (i.e., carotenes, tocols and n-3 PUFA), which are often scarce in poultry feed
- Genotypes with **higher foraging behavior** also showed **a negative correlation with the ability to store** bioactive compounds (feed + grass) in body meat

+	−
Kinetic activity	**PUFA stability**
Oxidative metabolism	**Meat antioxidants**
ROS production	**Oxidative balance**

- **Genetic selection for ESR should favor chickens with a good balance between foraging and recovery rates of bio compounds, given that active animals have lower storage efficiencies**

Future research should scrutinize the *in vivo* metabolism of these bioactive compounds for understanding the real destiny of them (maintenance, energy production, immune status etc).

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PPILOW PARTNERS

Thank you for your attention

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