The effect of different types of edible microalgae on health, production performance and meat quality parameters in broiler chickens
(preliminary results)

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INTRODUCTION

Microalgae have gained growing interest as a feed additive—not just because of their strong nutritional value, but also due to their rich content of bioactive compounds like:

Phenolics ↓	**PUFAs ↓**	**Oligosaccharides ↓**	**Carotenoids ↓**
Antioxidant	**Anti-inflammatory**	**Antibacterial**	**Antiviral**

(Van Nerom, 2024; El-Shall 2023; Abdel-Wareth, 2024)

Because of this, microalgal biomass is now seen as a promising tool to support poultry health and improve growth performance in a natural and sustainable way. But still there is a lack of information on the optimal intake of microalgae in broiler chickens.

This study was performed within the project "Development of plant origin feed supplement for strengthening poultry immunity and increasing nutritional value of eggs with omega-3 fatty acids" (grant Nr.: 22-00-A01612-000015) co-financed by European Agricultural Fund for Rural Development (EAFRD) and supported by the Ministry of Agriculture and Rural Support Service of the Republic of Latvia.

The aim of our study was to determine whether the supplementation of relatively low doses (0.5%) of Spirulina, Chlorella and a novel microalgae species in poultry production - *Tetradesmus obliquus* - under controlled conditions affects:

- health,
- body weight gain,
- feed conversion ratio (FCR) and
- meat quality parameters of broiler chickens.

Permit No. 152/2024 was obtained from the Food and Veterinary Service to conduct the experiment "The effect of feeding microalgae on the health, productivity and production quality of laying hens and broiler chickens".

MATERIALS AND METHODS

First phase of the project was conducted by University of Latvia, Laboratory of Industrial Microbiology and Food Biotechnology where a mixotrophic and autotrophic algae cultivation method was tested for increased polyunsaturated fatty acids (PUFA) production and their extraction from microbial biomass to improve the quality of bird feed.
Where *Tetradesmus obliquus* was one of the algae selected for inclusion in bird feed, which is the novelty of this study.

(Neiberts' photography)

The second phase - four study groups Control (BK), *Spirulina* (BS), *Chlorella vulgaris* (BC) and *Tetradesmus obliquus* (BT)) were established, each containing day-old Ros 308 broiler chickens (n=35, total n=140).

The broilers were reared for 43 days under controlled conditions according to the Ros 308 rearing recommendations.

All birds were fed the same diet with 0.5% of the respective microalgal supplement added to the BS, BC and BT groups.

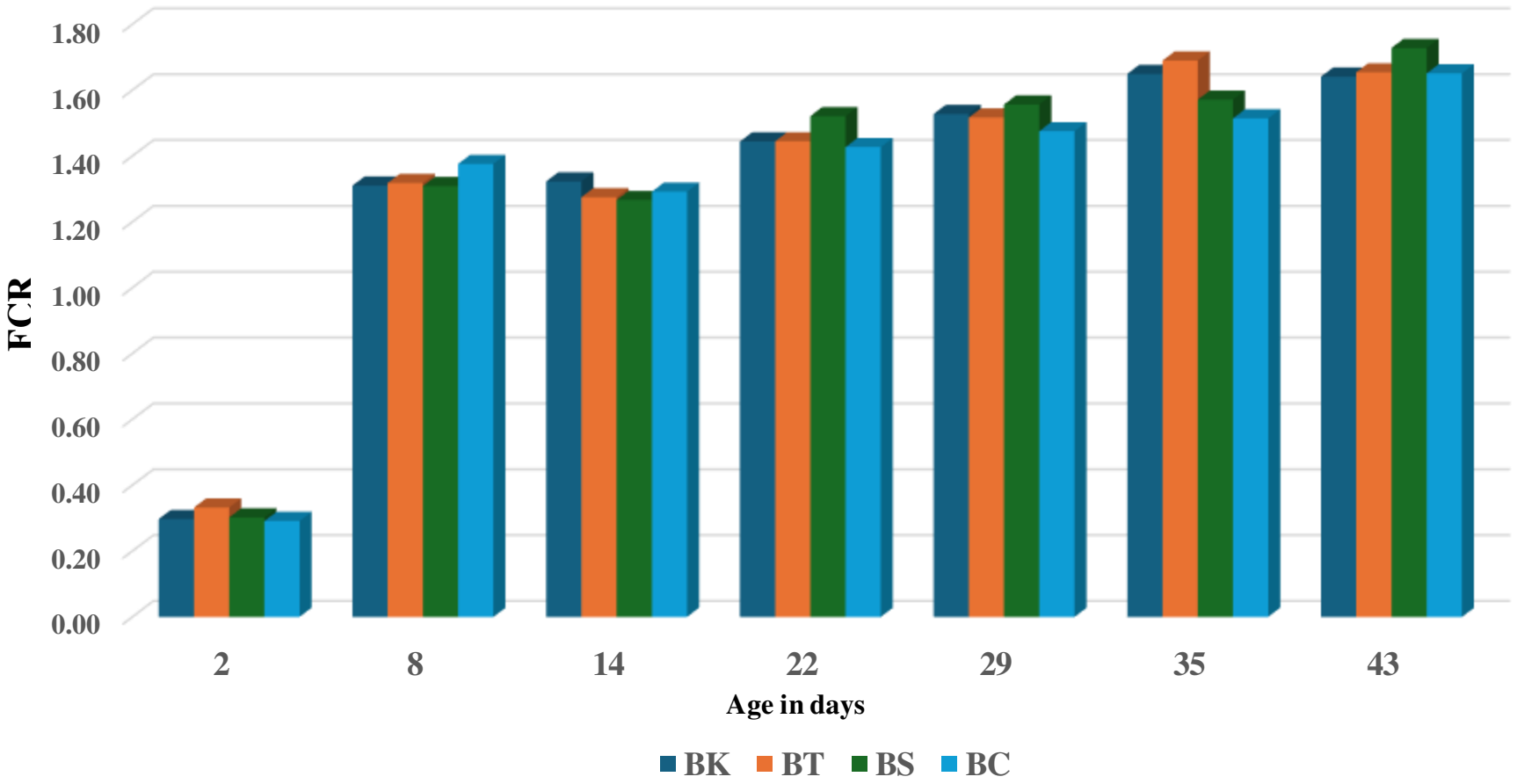
The results obtained (live weight gain, feed conversion ratio, breast and thigh meat quality parameters (MUFA; PUFA; omega-3; -6; -9, linoleic acid; α-linolenic acid and other fatty acids; water; energy (kcal); protein; fat; cholesterol) were compared between the groups.

Authors' photography

STATISTICAL ANALYSIS

- To assess the effects of different dietary treatments (*Chlorella*, *Spirulina*, *Tetradesmus*, and Control) on chicken weight and hematological parameters, 3 statistical approaches were employed.
- **Generalized Linear Models** (GLMs) were used to compare chicken weight and hematological values across treatment groups, while controlling for chicken age and weight.
- As thrombocyte and leukocyte counts were measured across multiple fields of view—introducing a random effect — **Generalized Linear Mixed Models** (GLMMs) with a negative binomial distribution were applied. "This approach allowed for comparison between treatment groups while controlling for chicken age and accounting for inherent variability in leukocyte counts across fields of view."
- To compare meat quality parameters, the **chi-squared test was conducted**.

RESULTS (1)



After adjusting for chicken age, no significant differences in chicken weight were observed between treatment groups ($p = 0.777$).

Food conversion ratio - but starting from the day 22nd Chlorella group consumed less amount of feed and had the lowest feed consumption per live weight gain achieving comparable final body weight to other groups.

RESULTS (2)

Hematological parameters (average number of leukocytes in the field of view): GLMM analysis revealed no significant differences in counts between the control group and other treatment groups.

					95% Confidence interval		
LEUKOCYTES	DAYS	N	MISSING	MEAN	LOWER	UPPER	SD
Control	14	100	0	4.54	4.03	5.05	2.556
	35	50	0	9.26	8.18	10.34	3.784
	43	70	0	9.46	8.59	10.33	3.654
TETRADESMUS	14	100	0	5.3	4.68	5.92	3.125
	35	50	0	8.44	7.63	9.25	2.837
	43	70	0	8.7	7.94	9.46	3.173
SPIRULINA	14	90	0	4.63	4.15	5.12	2.31
	35	50	0	9.56	8.53	10.59	3.609
	43	70	0	11.76	10.78	12.73	4.084
Chlorella	14	60	0	3.3	2.74	3.86	2.173
	35	50	0	11.06	10.13	11.99	3.285
	43	70	0	11.19	10.27	12.1	3.827

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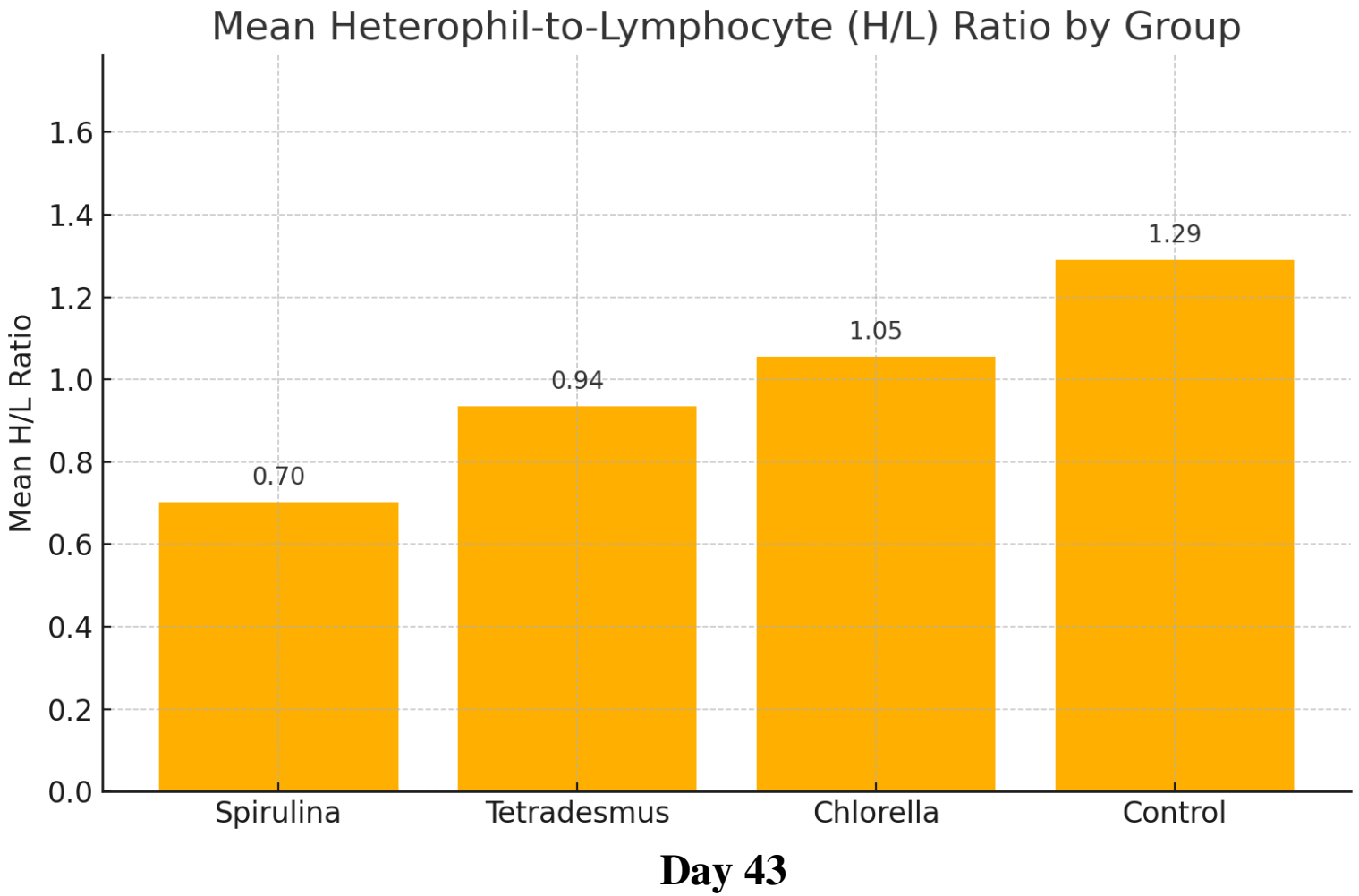
However:

- Leukocyte counts significantly differ **between the control and Spirulina groups** (p=0.013), with the Spirulina group having 11% higher leukocyte counts (95% CI: 2% – 21%).
- Leukocyte counts significantly differed **between the Spirulina and Tetradesmus groups** (p=0.012), with the Tetradesmus group having 10% lower leukocyte counts (95% CI: 2% – 13%).

RESULTS (3)

LEUKOCYTE FORMULA				
Leukocyte type	**Significant differences**	**P-value**	**Direction of effect**	**Effect size (95% CI)**
Heterophils	Control vs Spirulina	0.003	↓ Spirulina	–20% (95% CI: –29% to –8%)
	Control vs Tetradesmus	0.004	↓ Tetradesmus	–19% (95% CI: –31% to –4%)
Lymphocytes	Control vs Spirulina	0.012	↑ Spirulina	+27% (95% CI: +8% to +50%)
	Control vs Tetradesmus	0.015	↑ Tetradesmus	+25% (95% CI: +2% to +52%)
	Tetradesmus vs Chlorella	0.028	↓ Chlorella	–19% (95% CI: –34% to –2%)
Eosinophils	No significant difference	> 0.05	-	-
Monocytes	No significant difference	> 0.05	-	-

RESULTS (4)



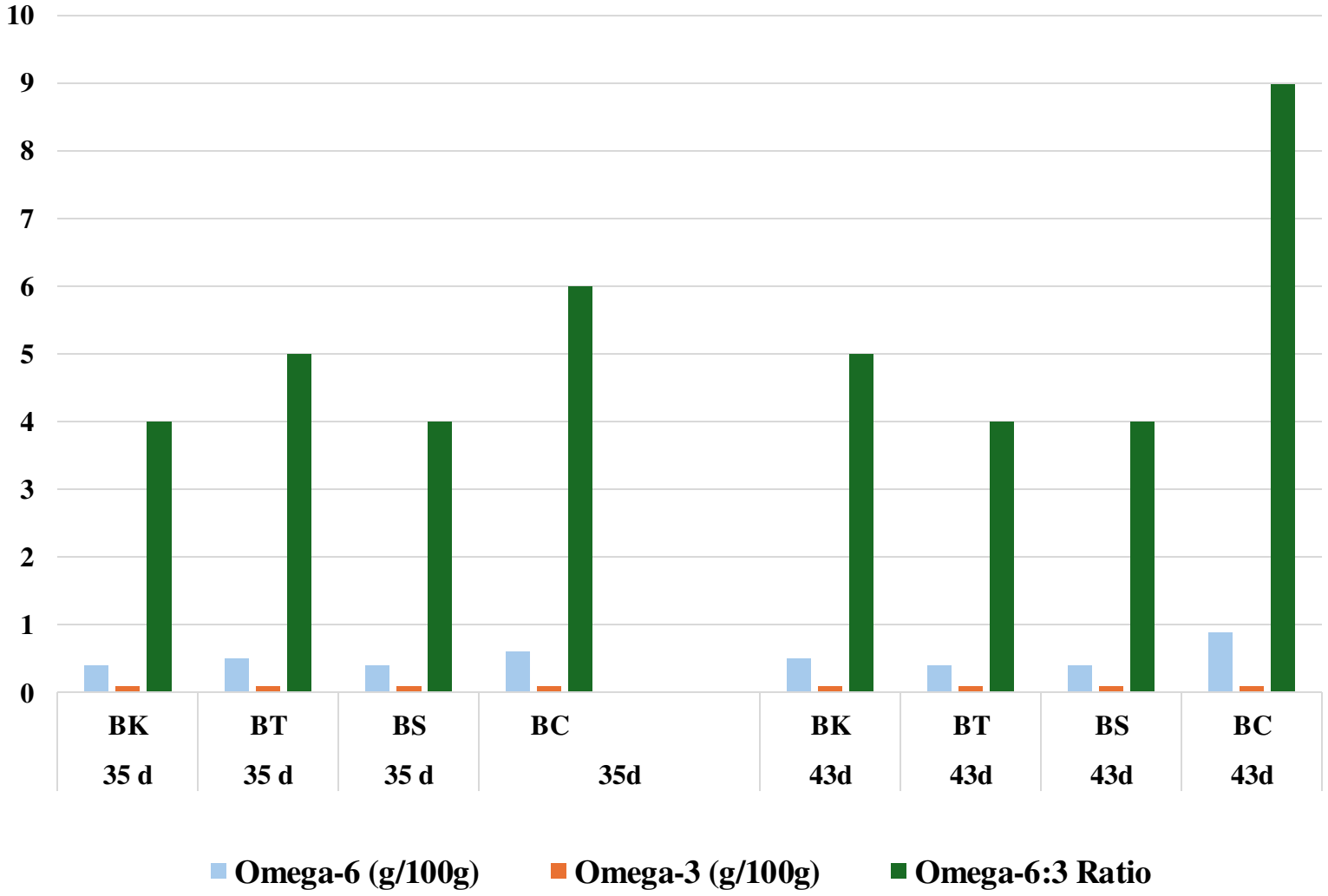
H/L ratio	Interpretation
< 0.5	Normal, unstressed chickens
0.5-1.0	Mild to moderate stress
> 0.8-1.0	Physiological stress or immune challenge
> 1.5-2.0 +	Strong immunological or hormonal stress

Gross & Siegel (1983)

The mean H/L ratio in the spirulina group (0,7) remained within the range expected for mildly stressed or stable birds, while the Control group exceeded 1.2 in some individuals, suggesting elevated physiological stress.

RESULTS

Meat quality: There is no difference in meat quality parameters between research groups ($p > 0.05$).



Ratio	Nutritional interpretation
≤ 4 : 1	ideal
5-6:1	moderate
≥ 9:1	undesirable

Simopoulos (2001)

CONCLUSION

- According to the preliminary data obtained and analyzed, microalgae did not worsen the health of the birds but improved certain health indicators.
- Chlorella supplementation may improve nutrient utilization efficiency in broiler chickens during the grower and finisher phases.
- Spirulina and Tetradesmus show promise as functional feed additives in broiler diets, capable of improving immune status and reducing physiological stress.
- Microalgae supplementation, particularly with Spirulina and Tetradesmus, contributes to a healthier omega-6:3 fatty acid ratio in broiler meat.

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