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Effects of Dietary Chia Polyphenols on Fatty acid Profile of Eggs in Heat-Stressed Japanese Quails †

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Abstract: A single paragraph of about 100 words to give a brief introduction to your work.

Keywords: chia; polyphenols; heat stress; fatty acid; poultry; Japanese quail

1. Introduction

Global warming is one of the main problems that poultry industry is currently facing, since high temperatures could generate oxidative stress and lead to changes on metabolism of energy, enzymatic functions, hormonal secretions and beyond. All these modifications impact considerably on the composition and quality of poultry products like eggs [1]. For example, fatty acid content in yolk's lipids could suffer modifications that diminish the nutritional quality of eggs. However, the effects of heat stress could be reversed by modifying nutritional composition of animal diet with phytochemical compounds like polyphenols [2]. An interesting and sustainable source of these compounds are the food industry by-products. These could be reused to obtain polyphenols, while reducing industrial waste. Therefore, the aim of this work was to study the effects of dietary supplementation with polyphenols from defatted chia seed cake on the fatty acids composition of eggs from Japanese quail exposed to heat stress.

2. Methods

In order to perform this study, a total of 24 females were randomly assigned into different groups (n = 12 per group) according to whether they were fed with standard commercial diet (BASAL) or chia polyphenol supplemented diet (500 mg polyphenol/Kg or CP500). Half of the animals in each diet group were exposed to heat stress with a cyclic schedule of temperature increase from 24 °C (thermoneutrality temperature) to 34 °C during 9 h in the light period [3]. Animals exposed to high temperatures were identified as HS (Heat Stress) groups and animals in thermoneutral temperature were identified as NHS (No Heat Stress) groups. After 23 days of experimental conditions eggs were collected, and lipids from yolks were extracted. Fatty acid

composition (proportion of saturated, monounsaturated and polyunsaturated fatty acids or SFA, MUFA and PUFA respectively) was analyzed by gas chromatography [4]. Analysis of variance (ANOVA) was performed to evaluate differences between results. In the case of significance ($p < 0.05$), a LSD Fisher or DGC comparison test was performed to reveal differences between the means.

3. Results

Egg yolks of HS-BASAL animals showed higher proportion of C20:0 and an increasing trend in C12:0, but with no significant differences in ΣSFA respect to those animals that had no heat stress and the same basal diet (NHS-BASAL). Besides, ΣMUFA decreased (mainly due to the reduction in C18:1 content), and no significant differences were observed in ΣPUFA. Regarding the effect of polyphenols, CP500 showed a decreasing trend in ΣSFA (specifically in C13:0, C16:0, C17:0 and with significant lower proportion of C20:0) and C16:1, (with no significant differences in ΣMUFA), but produced an increment of ΣPUFA (specifically C20:4 and C20:5, with an increasing trend in C18:2, C18:3, and C22:4) respect to BASAL diet in heat stress conditions. These results are very promising, since supplemented feeding could help to reverse the effect of heat stress and produce eggs enriched with PUFAS, which have higher nutritional importance because of their well-known effects on cardiovascular system.

Table 1. Results of fatty acids content in egg yolk.

	NHS		HS	
	BASAL	**CP500**	**BASAL**	**CP500**
C12:0	0.013 ^{ab}	0.009 ^{b}	0.023 ^{a}	0.017 ^{ab}
C13:0	0.017 ^{ab}	0.013 ^{b}	0.021 ^{ab}	0.014 ^{b}
C14:0	0.326	0.317	0.385	0.373
C15:0	0.029	0.018	0.034	0.028
C16:0	23.012 ^{a}	20.747 ^{b}	23.404 ^{a}	22.207 ^{ab}
C17:0	0.143 ^{a}	0.071 ^{b}	0.152 ^{a}	0.110 ^{ab}
C18:0	11.384	11.107	12.550	11.233
C20:0	0.013 ^{b}	0.017 ^{b}	0.035 ^{a}	0.018 ^{b}
ΣSFA	34.938 ^{a}	32.297 ^{b}	36.603 ^{a}	34.000 ^{ab}
C14:1	0.044	0.050	0.068	0.029
C16:1	3.229 ^{a}	3.030 ^{ab}	3.009 ^{ab}	2.353 ^{b}
C17:1	0.025	0.022	0.060	0.027
C18:1	40.898 ^{a}	40.710 ^{a}	37.055 ^{b}	38.203 ^{b}
C20:1	0.088	0.073	0.125	0.084
ΣMUFA	44.284 ^{a}	43.887 ^{a}	40.317 ^{b}	40.700 ^{b}
C18:2	17.198 ^{b}	18.877 ^{ab}	19.062 ^{ab}	19.633 ^{a}
C18:3	0.578 ^{b}	0.783 ^{ab}	0.826 ^{ab}	1.193 ^{a}
C20:4	2.685 ^{b}	3.460 ^{a}	2.387 ^{b}	3.577 ^{a}
C20:5	0.044 ^{bc}	0.067 ^{a}	0.042 ^{c}	0.057 ^{ab}
C22:4	0.075 ^{b}	0.154 ^{ab}	0.176 ^{ab}	0.225 ^{a}
C22:6	0.197 ^{b}	0.477 ^{a}	0.588 ^{a}	0.617 ^{a}
ΣPUFA	20.778 ^{b}	23.817 ^{ab}	23.080 ^{b}	25.300 ^{a}

Results are expressed as mean. Values with no letter in common are significantly different ($p < 0.05$) between different treatments. Values without letters did not show significant differences between any treatment.

4. Conclusions

In conclusion, the use of defatted chia seed cake seems to be a promising sustainable strategy to improve the nutritional quality of eggs in heat-stress conditions, while decreases the amount of wastes from food industry.

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