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Effects of Dietary White Lupin (*Lupinus albus*) Seed on Colour and Sensory Properties of Boiled Eggs

Tatiana Dumitra Panaite*, Gabriela Maria Cornescu, Cristina Camelia Matache, Ana Cișmileanu

Nutrition Physiology Department, National Research and Development Institute for Biology and Animal Nutrition, 077015 Balotesti, Ilfov, Romania;


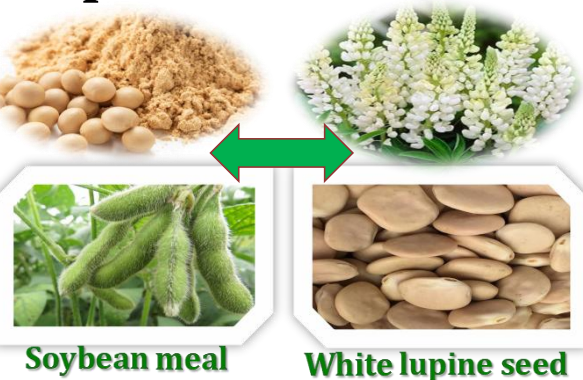

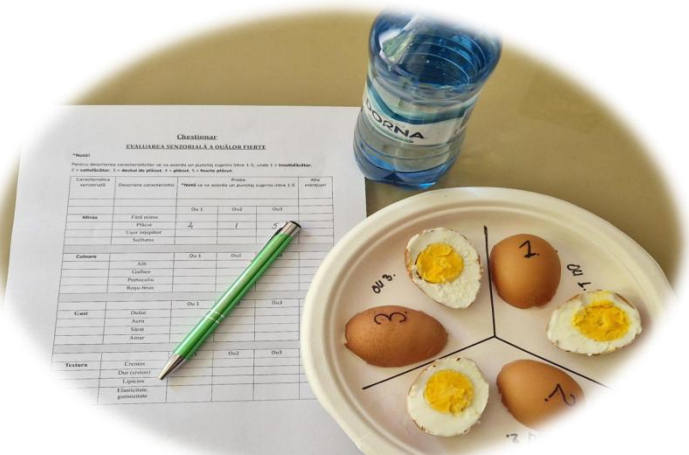
Abstract: This study evaluated the effects of dietary replacement of soybean meal (SBM) with white lupine seed (WLS) on fresh yolk color and sensory properties of boiled eggs. A 6-week feeding trial on 162 Lohmann Brown laying hens (30 weeks of age), divided into 3 groups (SBM; WLS_{15%} and WLS_{32.5%}) was done. At the end of the study, 126 eggs were randomly selected from all groups to evaluated the sensory quality by a panel of 14 trained members (42 evaluations per group). Eggs were boiled five minutes at 100 °C, peeled and cut in half, placed in the plate with an identification code and presented to the evaluators. The yolk colour value at the fresh eggs significantly ($p \leq 0.05$) increased at the WLM (15 or 32.5%) groups. L* parameter concomitantly decrease with the level of lupine increase, while a* and b* parameters show significant variations between groups. The flavour evaluation was significantly ($p \leq 0.05$) lower for the eggs provided by hens fed with WLS_{32.5%}, significantly decreasing both compared to SBM (with 45%) and WLS_{15%} (over 30%). This fact is due to the presence of quinolizidine alkaloids (32 g/kg) in the white lupine which led to obtaining the eggs with a bitter taste. In conclusion, white lupine seeds can be added to poultry diets up to 15% as a replacement for SBM without affecting egg quality.

• Introduction

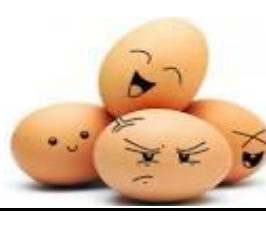
Typically, lupin (*Lupinus*) is considered as a substitute protein source for soybean meal, taking into account the presence of alkaloids that may have an adverse effect on animal performances and egg flavour (Gresta *et al.*, 2023). Yolk color has been established as an important trait for consumer perception along with taste, flavour, and texture (Rodoni *et al.*, 2020). Determining the length of the storage period and the repeatability of purchases requires exploring panelists' tasting impressions of consumers (Sipos *et al.*, 2021).

The aim of this study was to evaluate the effects of WLS on fresh yolk color and sensory properties of boiled eggs.


• Material and method

	Experimental data conditions		
	T1 (SBM)	T2 (WLS _{15%})	T3 (WLS _{32.5%})
✓ Hens (hybrid)	Lohmann Brown	Lohmann Brown	Lohmann Brown
✓ Experimental diets 	Conventional compound feed with 22.87% soybean meal, SBM)	White lupine seed (15%) at 50% replacing soybean meal in control diet	White lupine seed (32.5%) at 100% replacing soybean meal in control diet
✓ Total number of hens	162		
✓ Age of hens (weeks)	30		
✓ Period of rice feeding (days)	42		
✓ Yolk color measurement (as fresh sample) 	2 methods: a. YCF the DSM's YolkFan™ (color scale from 15 - dark orange, to 1 - light pale) using a digital egg tester ; b. a portable color spectrophotometer using the CIE-Lab system (Commission Internationale de l'Eclairage).		
✓ Sensory evaluation of eggs 	• personal data: name, gender, age, occupation, egg consumption frequency; • instructions for completing the questionnaire; • tasting panel for boiled eggs: 126 egg samples (42 eggs/group); 14 judge members; 3 days of evaluation; choice a score for attributes (flavour, color, taste and texture); • statisticaly analises;		

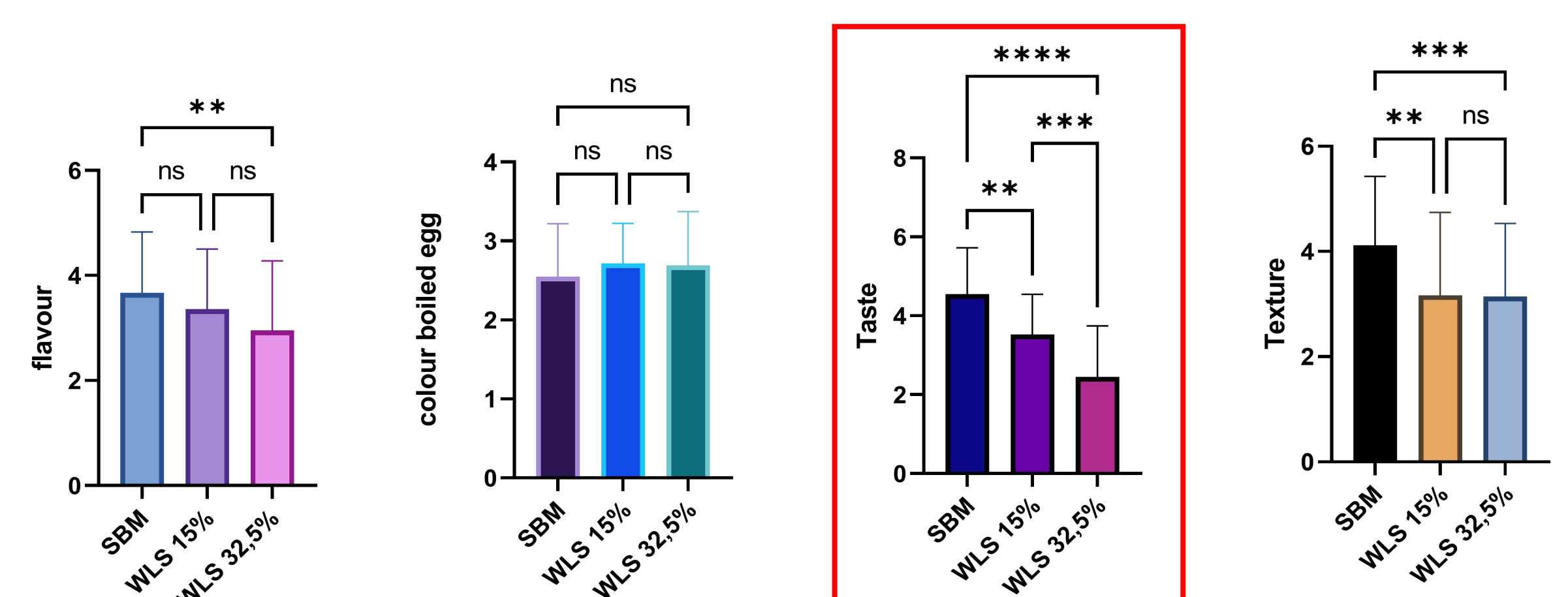
• Results and discussions

	Yolk quality parameters (average value/group)			SEM	p-Value
	SBM	WLS _{15%}	WLS _{32.5%}		
YW, (g)	14.40 ^a	14.42 ^a	11.23 ^b	0.459	0.0001
YP, (%)	24.34 ^a	24.22 ^a	19.96 ^b	0.706	0.001
YpH, (value)	5.95	6.15	6.28	0.120	0.169
YH, (mm)	16.45	17.20	17.33	0.345	0.184
YD, (mm)	39.62	39.00	37.00	0.967	0.169
YI	0.42 ^b	0.44 ^{ab}	0.47 ^a	0.012	0.024

SBM - standard diet with soybean meal; WLS15% - standard diet with 150 g/kg white lupine seed; WLS32.5% - standard diet with 325g/kg white lupine seed; YW - yolk weight; YP - yolk percentage; YpH - yolk pH; YH - yolk height; YD - yolk diameter; YI - yolk index; SEM - standard error of the mean; Means that do not share a letter are significantly different ($p \leq 0.05$)

	Yolk color indices (average value/group)			SEM	<i>p</i> -Value
	SBM	WLS _{15%}	WLS _{32.5%}		
<i>Egg yolk color measured values</i>					
RYCF	3.40 ^c	4.33 ^b	5.50 ^a	0.212	0.0001
L*	47.81 ^a	46.81 ^a	43.85 ^b	0.334	0.0001
a*	-0.91 ^c	-0.60 ^b	0.57 ^a	0.063	0.0001
b*	13.51 ^b	15.45 ^a	15.49 ^a	0.363	0.0001
<i>Egg yolk color calculated values</i>					
C* _{ab}	13.55 ^b	15.47 ^a	15.50 ^a	0.360	0.0001
E	49.71 ^a	49.31 ^a	46.52 ^b	0.395	0.0001
h _{ab}	-1.50 ^b	-1.53 ^c	1.53 ^a	0.005	0.0001
H° index	-85.94 ^b	-87.72 ^c	87.87 ^a	0.312	0.0001
ΔE*	-	2.82 ^b	5.47 ^a	0.187	0.0001

SBM - standard diet with soybean meal; WLS15% - standard diet with 150 g/kg white lupine seed; WLS32.5% - standard diet with 325g/kg white lupine seed; RYCF - yolk color fan scale consists of 15 different yellow tones from light yellow (1) to orange yellow (15); L* - a* - b* - indicators of the CIELAB system; C*_{ab} - chroma; h_{ab} - hue; E - colour; ΔE* - CIE total colour difference. Means that do not share a letter are significantly different; SEM - standard error of the mean; Means that do not share a letter are significantly different ($p \leq 0.05$);



• Conclusions:

- ❑ In conclusion, lupin is a potential protein sources in laying hen diets, but used in proportion up to 15%! Above this percentage, the egg quality can be dramatically impaired.
- ❑ Supplementation with white lupine up to 32.5% significantly deteriorates the sensory evaluation of egg yolks.

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