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The effect of replacing yellow peas with soybean meal in the diet of laying hens on egg quality.

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ABSTRACT

This study was conducted at the farm of the College of Agriculture, Department of Animal Production, Kirkuk University, from April 28, 2024, to August 4, 2024, to evaluate the effects of substituting yellow peas with soybean meal on egg quality in laying hens. A total of 140 hens were randomly assigned to seven dietary treatments, with varying inclusion levels of yellow peas (0%, 20%, 40%, and 60%) replacing soybean meal. Enzymes were also included as part of a duplicated treatment design. The experiment followed a completely randomized design, with four replications per treatment, and data were analyzed using ANOVA and Duncan's multiple range test at $P \leq 0.05$. Egg quality parameters, including egg weight, shell thickness, albumen height, yolk color, and Haugh unit, were measured. Results showed significant differences in egg weight during specific weeks but no overall differences among treatments. The egg shape index varied significantly among treatments, with the highest recorded in the soybean meal-based diet. Yolk percentage was highest in the 20% and 40% yellow pea treatments, while albumin percentage was highest in the 60% yellow pea treatment. Eggshell percentage remained unaffected by dietary changes. These findings suggest that yellow peas can partially replace soybean meal in laying hen diets without negatively affecting overall egg quality. However, minor variations in certain parameters indicate potential influences of dietary protein composition and amino acid balance.

Keywords: layer, Soybean meal, Yellow peas, replacing.

INTRODUCTION

Egg production plays a significant role in global food security, serving as a crucial source of high-quality protein, vitamins, and minerals for human consumption [1]. As the demand for sustainable and cost-effective poultry farming practices grows, researchers and producers are increasingly exploring alternative feed ingredients to reduce reliance on conventional protein sources [2, 3]. Among potential alternatives, yellow peas (*Pisum sativum*) have garnered attention due to their nutritional profile, availability, and environmental benefits. Soybean meal is the primary protein source in poultry diets due to its high protein content and favorable amino acid profile [4]. However, concerns regarding the environmental impact of soybean cultivation, including deforestation and greenhouse gas emissions, as well as the rising cost of SBM, have prompted the search for more sustainable feed options [5]. Yellow peas, which belong to the legume family, offer a promising alternative due to their high protein content, digestibility, and ability to fix atmospheric nitrogen, thereby reducing the need for synthetic fertilizers [6]. Furthermore, yellow peas are less susceptible to anti-nutritional factors compared to some other legumes, which enhances their suitability as a feed ingredient for poultry [7].

The inclusion of yellow peas in poultry diets has been the subject of several studies, particularly in broilers and growing hens. These studies highlight the potential of yellow peas to partially or completely replace SBM without compromising growth performance or feed efficiency [8]. However, the implications of substituting SBM with yellow peas in the diet of laying hens, particularly with respect to egg quality traits, remain underexplored. Feed composition directly influences these traits, as the nutrients and bioactive compounds present in the diet are incorporated into the egg during formation [9]. The nutritional composition of yellow peas supports their potential role in maintaining or enhancing egg quality. Yellow peas are rich in protein, carbohydrates, and essential amino acids, particularly lysine, which is crucial for protein synthesis and egg formation [10]. Additionally, they contain bioactive compounds such as oligosaccharides and phytochemicals that may have functional benefits [11]. However, the presence of moderate levels of trypsin inhibitors and tannins in peas necessitates proper processing or dietary adjustments to optimize their use [12].

Previous research has demonstrated that dietary modifications can significantly affect egg quality. For instance, replacing SBM with lupins, canola meal, or other legumes has shown variable effects on egg weight, yolk color, and shell thickness, depending on the inclusion rate and the overall nutrient balance of the diet [13]. This variability underscores the importance of evaluating yellow peas as a dietary component within the specific context of laying hens. In addition to their nutritional attributes, yellow peas align with the principles of sustainable agriculture. Their cultivation requires fewer inputs compared

to soybeans, and they contribute to soil health through nitrogen fixation [14]. Incorporating yellow peas into poultry diets could therefore reduce the environmental footprint of egg production while maintaining economic viability for farmers [15]. The research aims to provide insights into the potential of yellow peas as a sustainable and effective alternative protein source. The findings will contribute to the growing body of knowledge on feed innovation in poultry production and support the development of more sustainable practices in the egg industry.

Materials and Methods:

This study was conducted at the farm of the College of Agriculture. Department of Animal Production, Kirkuk University (28/4/2024 – 4/8/2024) To evaluate the effects of yellow peas substitutes on the egg quality of laying hens. 140 hens were randomly allocated to seven treatments. These include 0% yellow peas, 100% soybean meal, and 20%, 40%, or 60% soybeans, which are replaced with yellow peas. The treatments were duplicated using an enzyme. The experiment was designed for complete randomization, laying 20 eggs for each replication, four replications for each treatment; chickens were randomly allocated to seven treatments. All chickens were separated. They were kept in cages and provided with water throughout the entire experiment. Soy inclusion levels were determined based on previous studies that suggested optimal efficacy at these replacement levels. Table 1 shows the ingredients and nutritional composition of the experimental diets [16].

Table 1: Ingredients and Nutrient Composition of the Experimental Diets

Ingredients	0% control	20% YSP	40% YSP	60% YSP
wheat	15.80	33.40	46.20	44.20
corn	43.90	19.50	0.00	0.00
oil	1.00	1.30	1.50	0.90
Barley	4.00	4.00	4.00	0.00
soybean meal 48%	22.30	17.83	13.38	8.92
Yellow split peas20%	0.00	10.70	21.40	32.10
Laymix-2.5	2.50	2.50	2.50	2.50
lysine	0.00	0.00	0	0.00
Methionine	0.06	0.10	0.14	0.19
DCP	0.45	0.45	0.45	0.45
limestone	9.54	9.77	9.98	10.29
T. salt	0.20	0.20	0.20	0.20
Colin clorid	0.25	0.25	0.25	0.25
100.0Formula	100.0	100.0	100.0	100.0
ME/CP Ratio	160.532	160.305	161.632	168.804
Energy Kcal/kg	2724	2711	2704	2711
protein %	16.97	16.91	16.73	16.06
lysine %	1.502	0.825	0.746	0.656
Methionine	0.45	0.44	0.43	0.44
Met+CYST%	0.63	0.58	0.53	0.49
Ca %	4.505	4.505	4.496	4.518
p %	0.697	0.579	0.5598	0.542

The trial lasted 12 weeks. During this time, the chickens were raised in a controlled environment with a 16 h photoperiod/8 h dark photoperiod using an electronic scale. Chickens were weighed individually at the beginning and end of the study. Eggs were collected daily, and the following egg quality parameters were measured: Egg Weight: Measured using a digital scale with a precision of 0.01 g. Shell Thickness: Determined using a digital micrometer at three locations (blunt end, equator, and sharp end) and averaged. Albumen Height: Measured using a tripod micrometer. Yolk Color: Assessed using a Roche yolk color fan. Haugh Unit: Calculated using the formula provided by [17]. Data were subjected to analysis of variance (ANOVA) using SAS software, and the Duncan test was used for Separate means at a significance level of $P \leq 0.05$.

Results and discussion:

The study examined the impact of substituting yellow peas with soybean meal in laying hen diets on egg weight over six weeks. Significant differences in egg weight were observed during weeks 72–74, 78–80, and 82–84. In weeks 72–74, treatments 1, 5, and 6 produced heavier eggs compared to treatments 2, 4, and 7. During weeks 78–80, treatment 4 resulted in the heaviest eggs, while treatments 1, 5, and 7 had lighter eggs. In weeks 82–84, treatment 5 produced the heaviest eggs, with treatment 2 yielding the lightest. Overall, no significant differences in egg weight were noted among treatments. These findings align with previous research indicating that incorporating peas into laying hen diets can maintain egg production and quality. [18] found that replacing soybean meal with untreated field peas did not adversely affect egg production or quality. Similarly, [19] reported that including peas at 20% of the diet improved egg production and feed conversion, though higher

inclusion rates could reduce performance. [20] observed that substituting soybean meal with legume grains, including peas, did not significantly impact laying performance but did influence certain egg quality characteristics. These studies suggest that partial replacement of soybean meal with peas can be a viable strategy in laying hen diets without detrimental effects on egg weight.

Table 2: The effect of replacing yellow peas with soybean meal in the diet of laying hens Egg weight

Treatment	Period (Week)						Overall
	72-74	74-76	76-78	78-80	80-82	82-84	
1	67.65±1.55 a	63.40±1.54 a	60.44±1.32 a	58.72±1.89 b	60.87±2.79 a	65.86±2.37 ab	62.82±0.94 a
2	62.56±1.79 b	60.40±2.44 a	63.90±1.83 a	61.26±1.45 ab	59.71±2.50 a	60.20±3.41 b	61.34±0.91 a
3	64.05±1.43 ab	59.60±1.89 a	63.13±1.88 a	60.60±1.53 ab	59.41±3.50 a	62.75±1.96 ab	61.59±0.86 a
4	60.87±2.35 b	60.20±1.74 a	65.56±1.99 a	64.82±1.35 a	59.55±2.55 a	63.47±1.07 ab	62.41±0.83 a
5	67.44±0.50 a	59.80±1.39 a	63.93±2.12 a	58.80±2.06 b	64.44±1.65 a	68.74±0.57 a	63.86±0.88 a
6	67.46±0.50 a	61.20±2.89 a	63.50±1.12 a	61.71±1.58 ab	66.21±4.93 a	64.00±1.22 ab	64.01±1.02 a
7	61.84±1.81 b	61.20±2.42 a	64.04±1.10 a	58.51±1.91 b	57.48±1.74 a	66.01±3.44 ab	61.51±0.98 a
Sig.	*	N.S.	N.S.	*	N.S.	*	N.S

Sig= significant, a-b = indicate significant differences between means in same row. NS= non-significant

The egg shape index, which reflects the geometric proportions of eggs, was significantly influenced by dietary treatments at most time points ($p \leq 0.05$), except for weeks 80-82 and 82-84, where no significant differences were observed. Treatment 7 exhibited the highest overall egg shape index (78.26 ± 0.57), suggesting that the inclusion of soybean meal had a positive impact on egg shape compared to yellow pea-based diets. Conversely, Treatment 1 had the lowest overall index (75.68 ± 0.59), indicating potential limitations of yellow peas in maintaining optimal egg shape. These findings align with previous research indicating that dietary protein sources influence eggshell quality and egg morphology [21]. The higher egg shape index in Treatment 7 suggests improved eggshell formation, possibly due to a better amino acid profile from soybean meal [22]. However, the lack of significance in later weeks suggests a possible adaptation of hens to dietary changes [23]. Similar results have been reported in studies comparing alternative protein sources in poultry diets [24]. Further studies should explore the long-term implications of dietary protein replacement on eggshell strength and quality. Additionally, optimizing the inclusion levels of yellow peas and soybean meal could enhance production efficiency while maintaining egg morphology [25].

Table 3: The effect of replacing yellow peas with soybean meal in the diet of laying hens Egg shape index

Treatment	Period (Week)						Overall
	72-74	74-76	76-78	78-80	80-82	82-84	
1	73.18±1.31 c	75.87±1.35 ab	77.92±1.56 ab	75.35±1.71 ab	74.56±0.73 a	77.18±1.39 a	75.68±0.59 b
2	75.56±0.82 bc	74.91±1.72 b	78.32±1.16 ab	74.54±1.19 b	76.26±0.84 a	77.60±1.54 a	76.20±0.53 ab
3	74.05±0.58 bc	77.26±1.60 ab	75.59±1.01 ab	75.30±1.37 ab	77.39±1.16 a	76.18±1.09 a	75.96±0.49 b
4	78.66±0.47 a	77.10±0.75 ab	74.30±1.57 b	73.94±0.70 b	77.36±1.66 a	74.31±1.31 a	75.95±0.55 b
5	76.46±1.38 ab	77.28±1.50 ab	75.17±1.64 ab	73.95±1.15 b	80.96±7.39 a	75.63±1.13 a	76.58±1.28 ab
6	75.07±0.61 bc	75.72±1.64 ab	74.22±1.20 b	78.26±0.78 a	75.23±1.99 a	77.28±1.17 a	75.96±0.55 b
7	78.30±0.46 a	80.16±2.14 a	79.12±1.28 a	78.98±1.07 a	75.56±1.03 a	77.42±1.50 a	78.26±0.57 a
Sig	*	*	*	*	N.S.	N.S.	*

Sig= significant, a-b = indicate significant differences between means in same row. NS= non-significant

The results indicate that replacing yellow peas with soybean meal in the diet of laying hens had variable effects on yolk percentage. Treatment 6 exhibited the lowest overall yolk percentage (23.25%), while Treatment 2 (24.50%) and Treatment 3 (24.51%) had the highest values. Significant differences were observed between treatments in the 72–74 g ($p \leq 0.05$) and 78–80 g ($p \leq 0.05$) egg weight categories, with Treatments 2 and 3 showing higher yolk percentages. However, no significant differences were found in other weight categories ($p \geq 0.05$). Soybean meal is a rich protein source with a well-balanced amino acid profile, which may have influenced yolk deposition [16]. Previous studies suggest that dietary protein levels impact yolk composition, including lipid and protein deposition [20]. Additionally, anti-nutritional factors in yellow peas, such as protease inhibitors, could have limited nutrient absorption [26]. While significant effects were noted in certain weight categories, overall yolk percentage differences were minor, indicating that both ingredients can support egg quality [25].

Table 4: The effect of replacing yellow peas with soybean meal in the diet of laying hens on Yolk %

Treatment	72-74	74-76	76-78	78-80	80-82	82-84	Overall
1	22.61±0.57 bc	22.49±1.24 a	23.32±0.52 a	24.64±0.95 ab	24.79±0.75 a	23.60±0.72 a	23.57±0.35 a
2	22.99±0.76 ab	23.70±1.33 a	23.29±0.44 a	27.47±0.28 a	25.82±1.38 a	23.74±1.01 a	24.50±0.46 a
3	24.27±0.37 ab	22.59±0.92 a	24.53±0.77 a	27.16±1.51 a	23.81±1.42 a	24.71±1.41 a	24.51±0.50 a
4	25.14±1.05 a	23.04±1.15 a	23.43±0.52 a	22.78±1.08 b	22.67±1.53 a	23.73±1.28 a	23.47±0.45 a
5	23.12±0.68 ab	24.45±0.93 a	23.34±1.08 a	25.50±1.12 ab	24.72±0.54 a	22.90±1.13 a	24.01±0.39 a
6	20.52±0.43 c	23.49±1.65 a	24.41±0.41 a	22.89±1.18 b	23.82±2.20 a	24.34±0.55 a	23.25±0.53 a
7	24.73±1.09 ab	22.70±1.03 a	23.44±0.73 a	25.73±1.37 ab	22.51±1.31 a	22.30±0.84 a	23.57±0.47 a
Sig.	*	NS	NS	*	NS	NS	NS

Sig= significant, a-b = indicate significant differences between means in same row. NS= non-significant

The effect of replacing yellow peas with soybean meal on albumin percentage in laying hens showed variable results across different experimental periods. A significant difference was observed at weeks 72-74 and 80-82 ($p \leq 0.05$), while the other periods showed no significant differences ($p \geq 0.05$). Treatment 6 recorded the highest overall albumin percentage (64.69%), whereas treatment 2 had the lowest (63.31%). This suggests that soybean meal inclusion may positively influence albumin synthesis due to its superior amino acid profile, particularly in methionine and lysine, which are essential for protein synthesis in poultry [16]. Soybean meal is known for its higher digestibility and balanced amino acid profile compared to yellow peas, contributing to improved protein metabolism and egg quality [25]. Previous studies have also indicated that plant protein sources like soybean meal can enhance egg albumin content by optimizing nitrogen utilization [27]. However, variations across weeks might be attributed to environmental factors, hen physiology, or differences in feed intake [28].

Table 5: The effect of replacing yellow peas with soybean meal in the diet of laying hens on Albumin %

Treatment	Period (Week)						Overall
	72-74	74-76	76-78	78-80	80-82	82-84	
1	65.03±0.58 ab	66.28±1.70 a	64.41±0.64 a	60.73±1.84 a	63.50±0.96 bc	64.84±0.94 a	64.13±0.55 a
2	63.84±0.78 bc	63.96±1.85 a	64.56±0.73 a	60.18±0.50 a	61.97±2.02 bc	65.36±0.96 a	63.31±0.57 a
3	62.73±0.52 bc	65.30±1.56 a	62.67±1.05 a	60.05±2.35 a	63.35±1.57 bc	64.34±1.74 a	63.07±0.66 a
4	61.54±1.55 c	65.66±1.66 a	64.99±1.04 a	65.98±0.94 a	64.08±1.78 a	66.20±1.56 a	64.73±0.63 a
5	65.04±0.47 ab	63.27±0.63 a	64.57±1.46 a	58.32±2.13 a	63.12±0.74 c	66.18±0.75 a	63.42±0.64 a
6	67.54±0.37 a	64.32±2.10 a	62.76±0.53 a	65.12±1.87 a	63.17±2.74 ab	65.25±0.63 a	64.69±0.68 a
7	62.33±1.29 bc	65.30±1.64 a	64.29±0.89 a	60.70±1.16 a	65.72±1.92 bc	68.28±1.53 a	64.44±0.70 a
Sig.	*	NS	NS	NS	*	NS	NS

Sig= significant, a-b = indicate significant differences between means in same row. NS= non-significant

The effect of replacing yellow peas with soybean meal on eggshell percentage in laying hens showed variable outcomes across different periods (Table 6). During weeks 72–74 and 80–82, significant differences ($p \leq 0.05$) were observed among treatments, whereas other periods showed no significant effects. Treatment 4 exhibited the highest eggshell percentage at week 80–82 (13.26 ± 0.80%), while Treatment 5 had the lowest at week 72–74 (11.83 ± 0.28%). Overall, eggshell percentage remained statistically similar across treatments ($p \geq 0.05$). These findings suggest that soybean meal replacement does not drastically alter eggshell quality. Variability in results may stem from diet digestibility, calcium metabolism, or hen age [21]. Previous studies indicate dietary protein sources can influence eggshell strength [29]. However, in this study, the comparable overall percentages suggest that yellow peas can effectively replace soybean meal without negatively affecting eggshell quality. Further studies should explore long-term impacts.

Table 6: The effect of replacing yellow peas with soybean meal in the diet of laying hens on Eggshell %

Treatment	Period (Week)						Overall
	72-74	74-76	76-78	78-80	80-82	82-84	
1	12.36±0.28 abc	11.23±0.53 a	12.27±0.31 a	14.62±1.24 a	11.71±0.41 ab	11.56±0.92 a	12.29±0.34 a
2	13.16±0.47 ab	12.34±0.68 a	12.15±0.37 a	12.36±0.43 a	12.21±1.00 bc	10.90±0.53 a	12.19±0.26 a
3	13.00±0.33 abc	12.11±0.69 a	12.80±0.32 a	12.79±1.03 a	12.84±1.07 bc	10.95±0.77 a	12.41±0.31 a
4	13.31±0.58 a	11.30±0.64 a	11.65±0.37 a	11.24±0.78 a	13.26±0.80 c	10.06±0.32 a	11.81±0.32 a
5	11.83±0.28 c	12.28±0.58 a	12.09±0.64 a	16.18±1.05 a	12.15±0.35 a	10.93±0.53 a	12.58±0.39 a
6	11.94±0.22 bc	12.19±0.58 a	12.83±0.16 a	11.99±0.74 a	13.02±0.91 bc	10.41±0.22 a	12.06±0.26 a
7	12.94±0.39 abc	12.00±0.62 a	12.26±0.24 a	13.57±0.31 a	11.77±0.84 abc	9.41±0.94 a	11.99±0.33 a
Sig.	*	NS	NS	NS	*	NS	NS

Sig= significant, a-b = indicate significant differences between means in same row. NS= non-significant

The study examines the impact of substituting yellow peas with soybean meal in the diets of laying hens on eggshell thickness over a 12-week period. The results indicate that treatments 1, 2, and 3 maintained relatively consistent eggshell thicknesses, while treatments 4 through 7 exhibited a decline, particularly in the later weeks. Statistical analysis revealed significant differences among treatments during weeks 74-76, 76-78, 82-84, and overall ($p \leq 0.05$), suggesting that higher inclusion levels of soybean meal may adversely affect eggshell quality. These findings align with previous research indicating that the type and quality of protein sources in poultry diets can influence egg characteristics. For instance, [30] observed that incorporating rapeseed instead of soybean meal affected egg quality parameters, including eggshell weight and yolk index. Similarly, [31] reported that replacing soybean meal with sunflower seed meal did not adversely affect hen performance or egg quality, suggesting that alternative protein sources can be viable in poultry diets. However, the specific impact on eggshell thickness may vary depending on the alternative protein source. In contrast, studies exploring the replacement of soybean meal with microalgae such as Chlorella vulgaris have demonstrated improvements in egg quality parameters, including eggshell thickness [32]. This suggests that the nutritional composition of the substitute protein source plays a crucial role in determining its effect on eggshell quality. The observed decrease in eggshell thickness in treatments 4 through 7 may be attributed to imbalances in essential amino acids or other nutrients resulting from higher soybean meal inclusion rates. Ensuring a balanced amino acid profile is critical for maintaining eggshell quality, as deficiencies or excesses can impair calcium metabolism and eggshell formation [33].

Table 7: The effect of replacing yellow peas with soybean meal in the diet of laying hens on Eggshell thickness

Treatment	Period (week)						Overall
	72-74	74-76	76-78	78-80	80-82	82-84	
1	0.40±0.01 a	0.41±0.01 a	0.43±0.02 a	0.33±0.03 a	0.32±0.01 a	0.39±0.01 ab	0.40±0.01 a
2	0.42±0.01 a	0.41±0.01 a	0.39±0.02 ab	0.29±0.02 a	0.31±0.02 a	0.40±0.01 ab	0.37±0.01 ab
3	0.43±0.01 a	0.39±0.01 ab	0.39±0.01 ab	0.32±0.03 a	0.31±0.03 a	0.42±0.01 a	0.38±0.01 ab

4	0.40±0.01 a	0.39±0.02 ab	0.40±0.02 ab	0.27±0.03 a	0.32±0.07 a	0.38±0.01 ab	0.34±0.02 bc
5	0.41±0.02 a	0.39±0.02 ab	0.38±0.02 ab	0.27±0.02 a	0.33±0.02 a	0.37±0.02 b	0.30±0.03 c
6	0.41±0.01 a	0.35±0.02 b	0.36±0.02 b	0.31±0.03 a	0.31±0.01 a	0.37±0.01 b	0.30±0.03 c
7	0.39±0.01 a	0.38±0.01 ab	0.38±0.02 ab	0.32±0.02 a	0.31±0.01 a	0.36±0.02 b	0.30±0.03 c
Sig.	NS	*	*	NS	NS	*	*

Sig= significant, a-b = indicate significant differences between means in same row. NS= non-significant

The study investigates the impact of substituting yellow peas with soybean meal in laying hens' diets on the yolk index, a critical indicator of egg quality. The yolk index measures the ratio of yolk height to its diameter, reflecting yolk freshness and structural integrity. The results indicate significant variations across treatments and age intervals. Notably, Treatment 3 consistently exhibited higher yolk index values, suggesting that replacing yellow peas with soybean meal positively influences yolk quality. These findings align with previous research exploring alternative protein sources in poultry diets. For instance, [34] evaluated legume seeds and rapeseed meal as protein sources in laying hen diets and found that certain combinations could effectively replace soybean meal without compromising egg quality. Similarly, [20] assessed the effects of replacing soybean meals with legume grains and observed changes in egg quality characteristics, including yolk properties. These studies suggest that while alternative protein sources can be utilized, the specific type and inclusion levels are crucial for maintaining or enhancing egg quality. In the present study, the superior yolk index observed in Treatment 3 implies that soybean meal may provide a more balanced amino acid profile or better digestibility than yellow peas, thereby enhancing yolk quality. However, it's essential to consider that excessive inclusion of certain legumes can negatively affect performance and egg characteristics, as noted by [34]. Therefore, while soybean meal appears beneficial in this context, the optimal inclusion rate should be carefully determined to avoid potential adverse effects.

Table 8: The effect of replacing yellow peas with soybean meal in the diet of laying hens on Yolk Index

Treatment	72-74	74-76	76-78	78-80	80-82	82-84	Overall
1	0.46±0.01 bc	0.45±0.01 b	0.42±0.03 b	0.42±0.02 a	0.25±0.10 c	0.35±0.05 b	0.39±0.02 b
2	0.45±0.01 c	0.48±0.01 b	0.45±0.01 ab	0.42±0.01 a	0.42±0.02 b	0.43±0.01 ab	0.44±0.01 a
3	0.48±0.01 ab	0.47±0.01 b	0.44±0.01 ab	0.43±0.02 a	0.63±0.06 a	0.46±0.02 a	0.48±0.02 a
4	0.46±0.01 abc	0.49±0.02 b	0.47±0.01 a	0.38±0.02 a	0.46±0.05 b	0.41±0.01 ab	0.45±0.01 a
5	0.46±0.01 bc	0.48±0.01 b	0.46±0.01 a	0.44±0.01 a	0.39±0.03 bc	0.45±0.03 a	0.45±0.01 a
6	0.48±0.01 a	0.48±0.02 b	0.48±0.01 a	0.38±0.04 a	0.45±0.02 b	0.40±0.01 ab	0.45±0.01 a
7	0.46±0.01 abc	0.54±0.03 a	0.41±0.01 b	0.35±0.08 a	0.47±0.02 b	0.46±0.02 a	0.45±0.02 a
Sig.	*	*	*	NS	*	*	*

Sig= significant, a-b = indicate significant differences between means in same row. NS= non-significant

The study examined the impact of substituting yellow peas with soybean meal in the diets of laying hens, focusing on the Albumin Index over several weeks. The Albumin Index measures egg white quality, with higher values indicating better quality. Throughout the experimental periods (weeks 72-84), no significant differences were observed in the overall Albumin Index among the seven treatment groups, suggesting that replacing yellow peas with soybean meal did not adversely affect egg white quality. These findings align with previous research indicating that various protein sources can be utilized in poultry diets without compromising egg quality. For instance, [19] found that incorporating up to 40% peas in laying hen diets did not negatively impact production performance or egg quality parameters. Similarly, [34] reported that using legume seeds and rapeseed meal as protein sources effectively replaced soybean meal without detrimental effects on laying performance. Moreover, [35] demonstrated that processed full-fat soybeans could replace soybean meal in laying hen diets without affecting egg quality traits. These studies suggest that alternative protein sources, such as peas and processed soybeans, can be effectively used in laying hen diets without compromising egg quality.

Table 9: The effect of replacing yellow peas with soybean meal in the diet of laying hens on Albumin Index

Treatment	Period (week)						Overall
	72-74	74-76	76-78	78-80	80-82	82-84	
1	0.17±0.01 a	0.11±0.01 ab	0.11±0.01 ab	0.09±0.01 a	0.08±0.03 b	0.09±0.02 a	0.11±0.01 a
2	0.33±0.17 a	0.12±0.01 ab	0.12±0.01 a	0.11±0.01 a	0.13±0.03 ab	0.10±0.03 a	0.15±0.03 a
3	0.17±0.01 a	0.12±0.01 ab	0.11±0.01 abc	0.11±0.01 a	0.17±0.02 a	0.11±0.01 a	0.13±0.01 a
4	0.16±0.01 a	0.13±0.01 a	0.11±0.01 ab	0.11±0.01 a	0.12±0.02 ab	0.09±0.01 a	0.12±0.01 a
5	0.16±0.01 a	0.13±0.01 a	0.10±0.01 bc	0.11±0.01 a	0.10±0.01 ab	0.12±0.02 a	0.12±0.01 a
6	0.17±0.01 a	0.13±0.01 ab	0.11±0.01 ab	0.10±0.02 a	0.11±0.01 ab	0.10±0.01 a	0.12±0.01 a
7	0.18±0.01 a	0.10±0.01 b	0.09±0.01 c	0.10±0.01 a	0.10±0.03 ab	0.13±0.01 a	0.12±0.01 a
Sig.	NS	*	*	NS	*	NS	NS

Sig= significant, a-b = indicate significant differences between means in same row. NS= non-significant

Conclusion:

The study evaluated replacing soybean meal with yellow peas in laying hen diets, finding significant egg weight differences in weeks 72–74, 78–80, and 82–84, though overall differences were not significant. The egg shape index varied significantly except in weeks 80–82 and 82–84. Yolk percentage differed across weight categories, with treatment 6 lowest and treatments 2 and 3 highest. Albumin and eggshell percentages varied in some weeks but not overall. Eggshell thickness declined in later weeks with higher soybean meal inclusion, suggesting potential adverse effects, though both ingredients generally supported egg production and quality.

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تأثير استبدال البازلاء الصفراء بكسبة فول الصويا في علائق دجاج البياض على جودة البيض.

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الخلاصة
أُجريت هذه الدراسة في حقل الدواجن في قسم الإنتاج الحيواني، كلية الزراعة جامعة كركوك، للفترة من 28 نيسان 2024 إلى 4 آب 2024، لتقييم تأثير استبدال البازلاء الصفراء بكسب فول الصويا على جودة البيض في دجاج البياض. وُزّعت 140 دجاجة عشوائيًا على سبع معاملات، بمستويات مختلفة من البازلاء الصفراء (0%، 20%، 40%، و60%) بدلًا من كسب فول الصويا، أُدرجت الإنزيمات أيضًا كجزء من تصميم التجربة. اتبعت التجربة تصميمًا عشوائيًا تمامًا، بأربع مكررات لكل معاملة، وحُللت البيانات باستخدام تحليل التباين *(ANOVA)* واختبار دنكن عند قيمة $P \leq 0.05$. قُيست معايير جودة البيض، المتمثلة بوزن البيضة،

وسمك القشرة، وارتفاع الألبومين، ولون الصفار، ووحدة هاو. إذ أظهرت النتائج فروقًا كبيرة في وزن البيض خلال فترة التجربة، ولكن لم تظهر فروقًا عامة بين المعاملات. تباين معامل شكل البيضة بشكل كبير بين المعاملات، حيث سُجل أعلى مستوى له في العليقة التي استخدم فيها كسبة فول الصويا. كانت نسبة الصفار أعلى في معاملتي البازلاء الصفراء بنسبة 20% و40%، بينما كانت نسبة الألبومين أعلى في معاملة البازلاء الصفراء بنسبة 60%. ظلت نسبة قشر البيض غير متأثرة بالمعاملات المستخدمة. تشير هذه النتائج إلى أن البازلاء الصفراء يمكن أن تحل جزئيًا محل كسبة فول الصويا في علائق الدجاج البياض دون التأثير سلبًا على جودة البيض بشكل عام. ومع ذلك، تشير الاختلافات الطفيفة في بعض المعايير إلى تأثيرات محتملة لتركيب البروتين وتوازن الأحماض الأمينية.

الكلمات المفتاحية: الدجاج البياض، كسبة فول الصويا، بازلاء الصفراء، احلال.