Iraqi Journal of Market Research and Consumer Protection
(2026) 18(2): 251-261.
DOI:
Neamah & et al.,

المجلة العراقية لبحوث السوق
وحماية المستهلك

THE EFFECT OF USING PSYLLIUM SEED (*Plantago ovata*) POWDER IN BROILER DIETS ON SOME QUALITATIVE CHARACTERISTICS OF THE CARCASS AND CHEMICAL CHARACTERISTICS OF MEAT

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Received 19/ 5/ 2024, Accepted 1/ 9/ 2024, Published 30/ 6/ 2026

ABSTRACT

This experiment was conducted in the poultry field of the Poultry Research Station / Department of Livestock Research / Office of Agricultural Research for the period from January 13 to February 23, 2023. In this experiment, 300 one-day-old Ross308 chicks were used, with an average weight of 38.1 g. The chicks were distributed randomly upon the chambers at 10 birds for each replicant and in five treatments, and *Plantago ovata* seed were used in the diets at 0, 0.4, 0.6, 0.8 and 1% for each of the T1, T2, T3, T4 and T5. No significant differences were observed between the treatments for both the dressing percentage and the relative weights of the liver, heart, gizzard and neck. It also showed a high significant increase (P≤0.01) in the relative weight of the chest in treatments T3 and T4 compared to treatment T2. Treatments T2, T4 and T5 recorded a high significant increase (P≤0.01) in the relative weight of the thigh piece compared to the control treatment and the treatment T3. It is noted that there was a high significant increase (P≤0.01) in the relative weight of the drum stick for each of the treatments T1, T2 and T5 compared to the treatments T3, T4. The results showed a high significant decrease (P≤0.01) in fat oxidation indicators (malondialdehyde, peroxide value, free fatty acids) in all treatments of the experiment compared to the control treatment during the first period of meat storage .A high significant decrease (P≤0.01) in the concentration of total volatile nitrogen in treatments T4, T5 compared to the control treatment. A high significant increase (P≤0.01) in water holding capability of treatments T3, T4 and T5 compared to the control treatment .A high significant decrease (P≤0.01) in fat oxidation indicators (malondialdehyde, peroxide value, free fatty acids) in T3, T4, T5 compared to the control treatment in the second period of storage. A high significant decrease (P≤0.01) in the concentration of total volatile nitrogen in treatments T3, T4 and T5 compared to the control treatment. As for water holding capability of meat, the results showed a high significant increase (P≤0.01) in treatments T3, T4 and T5 compared to the control treatment. We conclude from this study that using Psyllium seed powder in diets by 0.4-1% may improve the physiological and immune-tissue characteristics of broilers.

Keywords: Broilers, Psyllium seed powder, lipid oxidation indicators, carcass qualitative characteristics.

تأثير استعمال مسحوق بذور السيلليوم *Plantago ovata* في علائق فروج اللحم في بعض الصفات النوعية للذبيحة والصفات الكيميائية للحم

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الخلاصة

اجريت هذه التجربة في حقل الدواجن لمحطة أبحاث الدواجن/ قسم بحوث الثروة الحيوانية/ دائرة البحوث الزراعية للمدة من13-كانون الثاني الى 23 – شباط – 2023 . استخدم في التجربة 300 فرخ نوع Ross 308 بعمر يوم واحد بمعدل وزن 38.1 غرام وزعت الافراخ عشوائياً على الحجرات وبواقع 10 طيور للمكرر الواحد و على 5 معاملات، استعملت بذور السيلليوم في العلائق وبنسبة 0 ، 0.4 ، 0.6 ، 0.8 ، 1 % لكل من المعاملة T_1، T_2، T_3، T_4 ، T_5. لم يلاحظ وجود فروق معنوية بين المعاملات لكلا من نسبة التصافي والاوزان النسبية للكبد والقلب والقانصة والرقبة. كما واظهرت حصول ارتفاع عالي المعنوية (P≤0.01) للوزن النسبي للصدر في المعاملات T4,T3 مقارنة بالمعاملة T2. وسجلت المعاملات T5,T4,T2 ارتفاعا عالي المعنوية (P≤0.01) في الوزن النسبي لوصلة الفخذ مقارنة بمعاملة السيطرة والمعاملة T3 . ويلاحظ حصول ارتفاع معنوي عالي (P≤0.01) في الوزن النسبي لعصا الطبال لكلا من المعاملات T5,T2,T1 مقارنة بالمعاملات T4,T3. و بينت النتائج حصول انخفاض عالي المعنوية (P≤0.01) في مؤشرات اكسدة الدهون (المالونديالهايد، قيمة البيروكسيد، الاحماض الدهنية الحرة) في جميع معاملات التجربة مقارنة بمعاملة السيطرة خلال المدة الاولى من خزن اللحم. انخفاض معنوي عالي(P≤0.01) في تركيز النيتروجين الكلي المتطاير في المعاملات T5,T4 مقارنة بمعاملة السيطرة.ارتفاع عالي المعنوية (P≤0.01) في قالبية الاحتفاظ بالماء للمعاملات T5,T4,T3 مقارنة بمعاملة السيطرة. حصول انخفاض عالي المعنوية (P≤0.01) مؤشرات اكسدة الدهون (المالونديالهايد، قيمة البيروكسيد، الاحماض الدهنية الحرة) T5,T4,T3 مقارنة بمعاملة السيطرة في المدة الثانية من الخزن . انخفاض معنوي عالي(P≤0.01) في تركيز النيتروجين الكلي المتطاير في المعاملات T5,T4,T3 مقارنة بمعاملة السيطرة. اما بالنسبة لقابلية اللحم الاحتفاظ بالماء اذ بينت النتائج حصول ارتفاع عالي المعنوية (P≤0.01) في المعاملات T5,T4,T3 مقارنة بمعاملة السيطرة. نستنتج من الدراسة ان استعمال مسحوق بذور السيلليوم في العلائق وبنسبة 0.4 – 1 % قد يحسن الصفات الفسلجية والمناعية النسيجية لفروج اللحم.

الكلمات المفتاحية: فروج اللحم، مسحوق بذور السيلليوم، مؤشرات اكسدة الدهن، الصفات النوعية للذبيحة.

INTRODUCTION

At the beginning of the third century, the poultry industry developed significantly, thus the demand for meat increased due to the increase of population on earth, which prompted those in charge of the poultry industry to produce fast-growing trading flocks with high food conversion efficiency, but they have low immunity **(Alsafi *et al.*, 2022).** In addition, he followed an intensive breeding system **(Ihab *et al.*, 2021)**. Which has led to problems for consumers in storing poultry meat due to the use of medicines and chemical compounds, which negatively affects the chemical and qualitative characteristics of the carcasses, which in turn is reflected in the impairment of some characteristics during transportation, storage and trading, thus in turn affects human health **(Hamody *et al.*, 2019)**. Which prompted researchers to use or find alternatives, including medicinal plants or medicinal essential oils **(Qassim, 2022)**. These additives work to improve the chemical and qualitative characteristics of the meat and protect the meat from impairment during storage **(Qasim *et al*,. 2017)**. One of the suggested additives

that may improve the qualitative and chemical characteristics of carcasses is psyllium seeds, because they are rich in protein and essential amino acids **(Shah *et al.*, 2010)**, in addition it contains a high percentage of healthy oils, especially omega-3 acids, which form 40.6% of the oil and omega acids 39.1% **(Coulston&Marcus, 2011)**. In addition, it is a rich source of the most important antioxidant compounds beta-carotene and ascorbic acid, which work to eliminate free roots and prevent their formation, especially preserving the qualitative characteristics of meat from impairment during storage **(Adom, 2017)**. Therefore, this study aims to know the effect of using psyllium seeds in broilers diets on the qualitative and chemical characteristics of the carcass.

MATERIALS AND METHODS

This experiment was conducted in the poultry field of the Poultry Research Station / Livestock Research Department / Office of Agricultural Research during the period from January 13 to February 23, 2023. In the experiment, 300 Ross 308 chicks, one day old, with an average weight of 38.1 grams, were used. The chicks were raised in a closed hall consisting of 30 chambers, and they were distributed randomly among the chambers in five treatments, each treatment had five replicants, and 10 birds for each replicant. The birds were fed on a diet with three stages, according to the table (1, 2, 3), in which psyllium seeds were used by 0, 0.4, 0.6, 0.8, 1% of the diet for each of the treatments T1, T2, T3, T4 and T5. Feed and water were provided freely "ad libitum" through out the experiment. The temperature was controlled using gas incubators, and the hall was equipped with continuous lighting, with turning of the lighting for one hour to accustom the birds to the power failure. At the age of 42, samples were taken and their carcasses were slaughtered at a rate of 5 birds per treatment in order to measure the relative weights of pieces and edible innards. Fat oxidation in the meat sample was measured by determining thiobarbituric acid according to the method of **Witte *et al.*, (1970).** The value of peroxide and free fatty acids in the meat was estimated according to the method of **Egan *et al.*, (1981)**, and the total volatile nitrogen was determined according to what was indicated by **Egan *et al.*, (1981)**. The experiment data were analyzed using the completely randomized design (CRD) with using the pre-made statistical program **(SPSS, 2017)**, and the significant differences between the means were compared using the Duncan Multinomial Test **(Duncan, 1955)**.

Table (1): Percentages of the components of the diets used in the study and their chemical.

The components%	Treatments				
	control	T_2	T_3	T_4	T_5
wheat	59	58.6	58.4	58.2	58
Soybean meal[1]	29	29	29	29	29
Protein Center[2]	5	5	5	5	5
psyllium seeds[3]	-	0.4	0.6	0.8	1
Sun oil	4.5	4.5	4.5	4.5	4.5
Di-calcium phosphate	0.7	0.7	0.7	0.7	0.7
table salt	0.1	0.1	0.1	0.1	0.1
limestone	1.22	1.22	1.22	1.22	1.22
methionine	0.24	0.24	0.24	0.24	0.24
Lysine	0.24	0.24	0.24	0.24	0.24
The total	100	100	100	100	100
Chemical Composition[4]					
Represented energy (kcal/kg feed)	3058.75	3065.27	3068.53	3071.79	3075.05
Crude protein (%)	23.30	23.34	23.37	23.39	23.42
Crude fiber (%)	3	3.1	3.1	3.2	3.2
Lysine (%)	1.42	1.42	1.42	1.42	1.42
methionine + cysteine(%)	1.07	1.07	1.07	1.06	1.06
Calcium (%)	0.99	0.99	0.99	0.99	0.99
Available Phosphorus (%)	0.50	0.50	0.50	0.50	0.50

composition in the starter diets

[1]The soybean meal used is from an Argentine source, the percentage of crude protein is 48%, and 2440 kilocalories / kg are represented as energy.

[2]The protein concentrate used is animal, produced by a Dutch company (imported) Brocon. It contains 40% crude protein, 2107 calories / kg protein as energy representative, 5% crude fat, 2.20% crude fiber, 5% calcium, 2.65% phosphorus, 3.85% lysine, 3.70% % methionine, 4.12% methionine + cysteine, 0.42% tryptophan, 1.70% threonine.

[3]psyllium seeds contain 24.4% crude protein, 4750 kilocalories. Kg-1 represented energy, 0.5 crude fat, 24.6% crude fiber, 0.006% calcium, 0.007% methionine + cysteine, 0.0071% lysine.

[4]According to the chemical composition based on (NRC **1994**).

Table (2): Percentages of the components of the diets used in the study and their chemical composition grower diets.

The components%	Treatments				
	control	T_2	T_3	T_4	T_5
wheat	63.54	63.14	62.94	62.74	62.54
Soybean meal[1]	25	25	25	25	25
Protein Center[2]	5	5	5	5	5
psyllium seeds[3]	-	0.4	0.6	0.8	1
Sun oil	4.5	4.5	4.5	4.5	4.5
Di-calcium phosphate	0.5	0.5	0.5	0.5	0.5
table salt	0.1	0.1	0.1	0.1	0.1
limestone	1.1	1.1	1.1	1.1	1.1
methionine	0.13	0.13	0.13	0.13	0.13
Lysine	0.13	0.13	0.13	0.13	0.13
The total	100	100	100	100	100
Chemical Composition [4]					
Represented energy (kcal/kg feed)	3102.80	3109.32	3112.58	3115.84	3119.10
Crude protein (%)	21.94	21.99	22.01	22.04	22.06
Crude fiber (%)	3	3.1	3.1	3.2	3.2
Lysine (%)	1.23	1.23	1.23	1.23	1.23
methionine + cysteine(%)	0.92	0.92	0.92	0.92	0.91
Calcium (%)	0.89	0.89	0.89	0.89	0.89
Available Phosphorus (%)	0.46	0.46	0.46	0.46	0.46

[1]The soybean meal used is from an Argentine source, the percentage of crude protein is 48%, and 2440 kilocalories / kg are represented as energy.

[2]The protein concentrate used is animal, produced by a Dutch company (imported) Brocon. It contains 40% crude protein, 2107 calories / kg protein as energy representative, 5% crude fat, 2.20% crude fiber, 5% calcium, 2.65% phosphorus, 3.85% lysine, 3.70% % methionine, 4.12% methionine + cysteine, 0.42% tryptophan, 1.70% threonine.

[3]psyllium seeds contain 24.4% crude protein, 4750 kilocalories. Kg-1 represented energy, 0.5 crude fat, 24.6% crude fiber, 0.006% calcium, 0.007% methionine + cysteine, 0.0071% lysine.

[4]According to the chemical composition based on (NRC 1994).

Table (3): Percentages of the components of the diets used in the study and their chemical composition, finisher diets.

The components%	Treatments				
	control	**T_2**	**T_3**	**T_4**	**T_5**
wheat	67.24	66.84	66.64	66.44	66.24
Soybean meal[1]	20	20	20	20	20
Protein Center[2]	5	5	5	5	5
psyllium seeds[3]	-	0.4	0.6	0.8	1
Sun oil	6	6	6	6	6
Di-calcium phosphate	0.4	0.4	0.4	0.4	0.4
table salt	0.1	0.1	0.1	0.1	0.1
limestone	1	1	1	1	1
methionine	0.13	0.13	0.13	0.13	0.13
Lysine	0.13	0.13	0.13	0.13	0.13
The total	100	100	100	100	100
Chemical Composition [4]					
Represented energy (kcal/kg feed)	3231.24	3237.76	3241.02	3244.28	3247.54
Crude protein (%)	20.01	20.05	20.08	20.10	20.13
Crude fiber (%)	2.9	3	3	3.1	3.1
Lysine (%)	1.09	1.09	1.09	1.09	1.09
methionine + cysteine(%)	0.86	0.86	0.86	0.86	0.86
Calcium (%)	0.81	0.81	0.81	0.81	0.81
Available Phosphorus (%)	0.44	0.44	0.44	0.44	0.44

[1]The soybean meal used is from an Argentine source, the percentage of crude protein is 48%, and 2440 kilocalories / kg are represented as energy.

[2]The protein concentrate used is animal, produced by a Dutch company (imported) Brocon. It contains 40% crude protein, 2107 calories / kg protein as energy representative, 5% crude fat, 2.20% crude fiber, 5% calcium, 2.65% phosphorus, 3.85% lysine, 3.70% % methionine, 4.12% methionine + cysteine, 0.42% tryptophan, 1.70% threonine.

[3]psyllium seeds contain 24.4% crude protein, 4750 kilocalories. Kg-1 represented energy, 0.5 crude fat, 24.6% crude fiber, 0.006% calcium, 0.007% methionine + cysteine, 0.0071% lysine.

[4]According to the chemical composition based on (NRC 1994).

RESULTS AND DISCUSSION

In Table (4) no significant differences were observed between the treatments for the clearance percentage and the relative weights of the liver, heart and gizzard. Table (5) shows the effect of using psyllium seeds in broilers diets on the relative weights of the pieces, as it is observed that there was a high significant increase (P≤0.01) in the relative weight of the breast in treatments T3 and T4 compared to treatment T2. Treatments T2, T4 and T5 recorded a high significant increase (P≤0.01) in the relative weight of the thigh piece compared to the control treatment and T3 treatment. It is observed that there was a high significant increase (P≤0.01) in

the relative weight of the drum stick for each of the treatments T1, T2 and T5 compared to the treatments T3, T4. The results showed a high significant increase (P≤0.01) in the relative weight of the back and wings in treatment T2 compared to other treatments. No significant differences were observed between the treatments of the experiment in the relative weight of the neck.

Table (4): The effect of using psyllium seeds in broilers diets on the dressing percentage, gizzard, heart and liver, mean ± standard error.

%	Treatment					Sg
	T_1	T_2	T_3	T_4	T_5	
Dressing percentage	72.79±0.82	73.52±0.74	73.70±0.53	71.89±0.40	71.91±0.56	Ns
gizzard	1.44±0.05	1.42±0.04	1.32±0.07	1.38±0.07	1.42±0.04	Ns
heart	0.61±0.03	0.54±0.04	0.56±0.04	0.53±0.02	0.59±0.04	Ns
Liver	2.31±0.15	2.24±0.05	2.23±0.10	2.19±0.11	2.16±0.15	Ns

*The different letters between the averages in one line indicate the presence of significant differences at the level of 0.05, NS the absence of significant differences. T1: control treatment, T2: 0.4% psyllium seeds were used, T3: 0.6% psyllium seeds were used, T4: 0.8% psyllium seeds were used, T5: 1% psyllium seeds were used.

Table (5): Effect of using psyllium seeds in broiler diets on relative weights of cuts, mean ± standard error.

%	Treatment					Sg
	T_1	T_2	T_3	T_4	T_5	
Breast	43.96±0.60ab	38.47±1.22b	47.56±2.35a	47.62±0.81a	42.48±2.48ab	**
Thigh	13.89±0.09b	15.76±0.29a	14.41±0.22b	15.65±0.71a	16.13±0.39a	**
Drumstick	12.60±0.33a	12.25±0.14a	11.37±0.10b	11.78±0.23b	13.38±0.40a	**
back	17.39±0.18ab	19.84±2.44a	15.52±2.91b	12.37±0.93c	15.28±1.82b	**
wings	9.12±0.43ab	9.83±0.26a	8.60±0.35b	9.79±0.19ab	9.27±0.20ab	**
Neck	3.04±0.18	3.87±0.83	2.54±0.14	2.80±0.09	3.46±0.12	Ns

**The different letters between the averages in one line indicate the presence of significant differences at the level of 0.01, NS the absence of significant differences. T1: control treatment, T2: 0.4% psyllium seeds were used, T3: 0.6% psyllium seeds were used, T4: 0.8% psyllium seeds were used, T5: 1% psyllium seeds were used.

Table 6 shows the effect of using psyllium seeds in broilers diets on indicators of fat oxidation in the meat, volatile nitrogen and the meat capability of holding water and for one day after slaughter. The results showed a high significant decrease (P≤0.01) in the concentration of malondialdehyde in all treatments of the experiment compared to the control treatment. Treatment T5 had a high significant decrease (P≤0.01) in malondialdehyde concentration compared to the other treatments of the experiment. As for the concentration of the peroxide value, a high significant decrease (P≤0.01) was observed in the treatments T4 and T5 compared to the control treatment. In addition, it was observed that a high significant decrease (P≤0.01) was obtained in the peroxide value for the treatment T5 compared to the treatments T2, T3. The results showed a high significant decrease (P≤0.01) in the percentage of fatty acids in treatments T3, T4 and T5 compared to the control treatment. The results also showed a high significant decrease (P≤0.01) in the concentration of total volatile nitrogen in the T4 and T5 treatments compared to the control treatment. As for the meat capability of holding water, the results showed a high significant increase (P≤0.01) in treatments T3, T4 and T5 compared to the control treatment. In addition, treatment T5 recorded a high significant increase (P≤0.01) compared to treatments T2, T3.

Table (6): The effect of using psyllium seeds in broilers diets on indicators of fat oxidation, total volatile nitrogen and water holding capability in meat during a storage period of 1 day, mean ± standard error.

Traits	Treatment					Sg
	T1	T2	T3	T4	T5	
MDA mg/kg	0.0458±0.0009a	0.0408±0.0004ab	0.0376±0.0002b	0.0306±0.0002bc	0.0264±0.0002c	**
PV meq/kg	4.17±0.01a	4.06±0.01ab	4.01±0.01ab	3.92±0.00b	3.84±0.01c	**
FFA %	0.47±0.01a	0.41±0.01ab	0.35±0.01b	0.30±0.02bc	0.27±0.01c	**
TVN mg N/100g	6.53±0.02a	6.34±0.01ab	6.14±0.01ab	6.02±0.01bc	5.87±0.01c	**
WHC %	29.40±0.05c	30.36±0.06bc	35.49±0.03b	38.41±0.07ab	40.21±0.04a	**

**The different letters between the averages in one line indicate the presence of significant differences at the level of 0.01, NS the absence of significant differences. T1: control treatment, T2: 0.4% psyllium seeds were used, T3: 0.6% psyllium seeds were used, T4: 0.8% psyllium seeds were used, T5: 1% psyllium seeds were used.

(Table, 7) shows the effect of using psyllium seeds in broilers diets on indicators of fat oxidation in the meat, volatile nitrogen and the meat capability of holding water and for a

storage period of 30 days after slaughter. The results showed a high significant decrease (P≤0.01) in the concentration of malondialdehyde in the treatments T3, T4 and T5 compared to the control treatment, and T5 treatment showed a high significant decrease (P≤0.01) in the concentration of malondialdehyde compared to the other treatments of the experiment. As for the concentration of both the peroxide value and free fatty acids, a high significant decrease (P≤0.01) was observed in all treatments of the experiment compared to the control treatment. In addition, it was observed that a high significant decrease (P≤0.01) was obtained in the peroxide value for treatment T5 compared to treatments T2 and T3. The results also showed a high significant decrease (P≤0.01) in the concentration of total volatile nitrogen in treatments T3, T4 and T5 compared to the control treatment. Treatment T5 recorded a high significant decrease (P≤0.01) in the concentration of total volatile nitrogen compared to the other treatments of the experiment. As for the meat capability of holding water, the results showed a high significant increase (P≤0.01) in treatments T3, T4 and T5 compared to the control treatment. In addition, treatment T5 recorded a high significant increase (P≤0.01) compared to treatments T2, T3.

Table (7): The effect of using psyllium seeds in broilers diets on indicators of fat oxidation, total volatile nitrogen and water holding capability in meat during the storage period of 30 days, mean ± standard error.

Traits	Treatment					Sg
	T1	T2	T3	T4	T5	
MDA mg/kg	0.0680±0.007a	0.0604±0.002ab	0.0462±0.001b	0.0410±0.003b	0.0344±0.002c	**
PV meq/kg	6.90±0.01 a	5.48±0.01b	5.04±0.01b	4.59±0.01c	4.29±0.02c	**
FFA %	0.65±0.02 a	0.53±0.02 b	0.44±0.01bc	0.38±0.01c	0.34±0.01c	**
TVN mg N/100g	7.85±0.01a	7.14±0.01ab	6.85±0.02b	6.54±0.01bc	6.33±0.01c	**
WHC %	22.60±0.02c	25.45±0.02bc	30.20±0.02b	33.48±0.02ab	38.51±0.01a	**

**Different letters between the averages in one line indicate the presence of significant differences at the 0.01 level, NS, there are no significant differences. T1: Control treatment, T2: Psyllium seeds were used at a rate of 0.4%, T3: Psyllium seeds were used at a rate of 0.6%, T4: Psyllium seeds were used at a rate of 0.8%, T5: Psyllium seeds were used at a rate of 1%.

The reason may be due to the improvement in the chemical characteristics of the meat and the decrease in indicators of fat oxidation and volatile nitrogen in the meat. The reason

may be due to the use of psyllium seeds in broilers diets, which stimulates the liver to produce antioxidant enzymes such as glutathione peroxidase, preventing the formation of free radical **(Alsafi *et al.*, 2022)**.The reason for the decrease in fat oxidation indicators in meat may be due to the use of psyllium seeds because they are one of the rich sources of omega 3 and 6 acids and carotenoid pigments, which prevent the formation of free roots by binding to the terminal groups of ionic oxygen by granting an electron to the ionic terminals and moving it from the Carotenoids pigments to free roots, which make free roots inoperative **(Pérez-Gálvez *et al.*, 2020**). The results of researches showed that beta-carotene has the ability to reduce the levels of Reactive Oxygen species (ROS) by inhibiting fats peroxidation by Copper Chlorophyllin Complex, by stimulating the body and increasing the formation of enzymes that decompose peroxides, such as the enzyme glutathione peroxidase (GPX), Catalase enzyme (CAT) and Superoxide dismutase enzyme (SOD)**(Suparmi *et al.*, 2016, Ihab *et al*., 2021).**

CONCLUSION

We conclude from this study that using Psyllium seed powder in diets by 0.4-1% may improve the physiological and immune-tissue characteristics of broilers.

REFERENCES

1. Adom, M. B., Taher, M., Mutalabisin, M. F., Amri, M. S., Abdul Kudos, M. B., Wan Sulaiman, M. W. A., Sengupta, P., & Susanti, D. (2017). Chemical constituents and medical benefits of Plantago major. *Biomedicine & pharmacotherapy = Biomedecine & pharmacotherapie*, *96*, 348–360.
2. Al-Safi, N.H.J. & Zangana, B.S.R., (2022)2. Effect of using raw and treated quinoa seeds (Chenopodium quinoa) in the diets on some microbial, physical and chemical properties of broiler carcass. *Journal of Kerbala for Agricultural Sciences*, *9*(2), pp.46-66.
3. Duncan, D. B. (1955). Multiple rang and multiple F tests. *Biometrics ,11;1-42*.
4. Egan, H., Kirk, R.S. & Sawyer, R. (1981). Pearson's Chemical Analysis of Foods. 8th Edition, Churchill Livingstone, New York.23 - 59.
5. Hamody, S.J., Qassim, A.A. & Bandar, L.K. (2019). The effect of adding different levels of green tea powder (Camellia sinensis) to the diet on productive performance for meat broilers. *Biochemical and Cellular Archives*, *19*(2), pp.2897-2901.
6. Ihab A. J. Awadh & Bushra S.R. Zangana. (2021). Effect of Adding Different Levels of Astaxanthin Extracted from an Algae Haematococcus Pluvialis to The Diet on Some Immunological Characteristics of Broilers Reared Under Natural and Elevated Environmental Conditions. *IOP Conf. Ser.: Earth Environ. Sci.* 910 012003.
7. Marcus, R. & Coulston, A. M. (2001). Fat soluble vitamins. In: Pharmacological Basis of Therapeutics. Gillman and Goodman. 2: 1553- 1570.
8. NRC, (1994). Nutrient Requirements of Poultry National Research Council .9 rev. ad. Natl. Acad. Press Washington. DC.

9. Pérez-Gálvez, A., I. Viera & M. Roca. (2020). Carotenoids and Chlorophylls as Antioxidants. Antioxidants. 9: 505.
10. Qasim, A.A., L.K. Bandr & F.M. Alkhilani. (2017). Effect of adding dietary conjugated linoleic acid to broiler diets on production performance and fatty acid content in meat. Pak. J. *Nutr.16(7):497-501*.
11. Qassim, Al-Hassan A., Luma K. Bandr, & Firas M. Alkalani. (2022). Effect of Using Avocado and Chia Oil and their Mixture in Meat Broiler Diets on Some Physiological and Microbial Characteristics of Blood Plasma. *NeuroQuantology.20(4):233-234*.
12. Shah, A., P. Sharma, V. Singh S.L. Gourl, D.K. Kothar, S.A. Ganie & Y. Shah. (2020). Antioxidant, Nutritional, Structural, Thermal and Physico-Chemical Properties of Psyllium (*Plantago ovata*) Seeds India, Amity Institute of Biotechnology, Amity University Rajasthan Jaipur.
13. SPSS® 22.0. Computer Software, (2017). SPSS Inc. Headquarters, 233 p., Wacker Drive, Chicago, Illinois. 60606, USA.
14. Suparmi, S.; M. Fasitasari; M. Martosupono & J.C. Mangimbulude .(2016). comparisons of curative effects of chlorophyll from *Sauropus androgynus* (l) merr leaf extract and Cu-chlorophyllin on Sodium nitrate-induced oxidative stress in rats. *J. Toxicol. 8515089*.
15. Witte V.C., G.F. Krause & M.F. Bailey. (1970). A new extraction method for determining 2-thiobarbituric acid values of pork and beef during storage. *J. Food Sci. 35:582–585*.