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Impact of adding different levels of fenugreek and thyme leaves to the diet on some productive and physiological traits of broiler

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Abstract

The study aimed to evaluate the effect of adding fenugreek and thyme leaf powders at different levels to the diet and their impact on the production and physiological traits of broiler chickens. A total of 210 one-day-old Ross 308 chicks were used, which were divided into seven treatments, with three replicates for each treatment and 10 birds/ replicate. The treatments were as follows: T1 (control treatment, without additives, basic diet), T2 basic diet with the addition of 2 g of fenugreek powder/kg, T3 basic diet with the addition of 4 g of fenugreek powder/kg, T4 basic diet with the addition of 2 g of thyme powder/kg, T5 basic diet with the addition of 4 gof thyme powder/kg, T6 basic diet with the addition of 1 gm of fenugreek powder and 1 g of thyme powder/kg, and T7 basic diet with the addition of 2 g of fenugreek powder and 2 g of thyme powder/kg. Treatments T2 (basic diet with the addition of 2 g of fenugreek powder/kg) and T5 (basic diet with the addition of 4 g of thyme powder/kg) significantly affected (P≤0.05) body weight, weight gain, feed intake, and feed conversion ratio. Fenugreek also altered the morphology of the intestines by increasing the height of the villi relative to the depth of the crypts.
Keywords: Fenugreek ,Thyme, Meat Chicken

Introduction

In recent decades, the poultry industry has developed significantly due to the increasing demand for its products, as it is one of the most important sources of animal protein. The adoption of genetic improvement methods has been accompanied by a substantial decline in the immunity and resistance of birds, leading to an increase in their susceptibility to diseases [1]. The poultry industry is currently moving towards reducing the use of synthetic antibiotics and finding natural alternatives. Studies indicate that the presence of materials and extracts from various herbs has appetite-enhancing properties, digestive stimulants, and antimicrobial effects. Additionally, they promote the growth of beneficial bacteria and reduce the activity of harmful (pathogenic) bacteria in the digestive system of poultry [2]. Plants contain many active compounds with wide-ranging chemical and therapeutic properties, which are used to treat various infections and bacterial, fungal, and other diseases by stimulating the digestive system of domesticated animals and birds, thereby improving organ

function [3]. In poultry production, herbs have become an alternative to antibiotics in poultry farming. These alternatives that replace antibiotics are referred to as plant-based feed additives, including probiotics, prebiotics, enzymes, and essential oils, which primarily act as growth stimulants to enhance intestinal health for optimal performance [4]. Herbal medicines have become increasingly popular, as they protect the body from the harmful effects of certain pollutants through the presence of natural antioxidants. Their use as alternatives to synthetic drugs has also become more common [5]. Among these herbal alternatives are fenugreek and thyme, which are considered important medicinal plants and have been a primary source for the treatment and healing of many diseases since ancient times. They have gained widespread use in the field of animal production to improve production efficiency in animals and enhance their immunity [6].

Among these is Fenugreek, which contains a rich chemical composition including flavonoids, phenolic compounds, and saponins, highlighting its significant medical and nutritional importance [7]. Additionally, important plants such as Thyme (Thymus vulgaris) contain various active substances like thymol, carvacrol, phenolic acids, and some flavonoids, as well as exhibiting antimicrobial properties, particularly in reducing the numbers of Escherichia coli and the total count of harmful microbes in the intestines [1].

The objective of the study was to evaluate the effect of adding fenugreek and thyme powder at different levels to the feed on certain productive and physiological traits of broiler chickens.

Materials and Methods

This study was conducted at the poultry farm in the Animal Production Department at the College of Agriculture, Kerbala University, to investigate the effect of adding Fenugreekand thyme leaf powder at different levels to the diet and its impact on the productive and physiological traits of broiler chickens. In this study, approximately 210 one-day-old chicks (Ross 308) from a local hatchery were used, with an initial weight ranging from 39 to 41 grams. The chicks were randomly distributed into pens (10 chicks per pen) and divided into seven treatments, each with three replicates, and the chicks were fed according to the diet outlined in Table 1. Feed and water were provided freely to the chicks

Composition of the Provided Diet

Table (1): Composition of the diets used and their chemical analysis during the starter and finishing periods

Feed Ingredients	The period from one day old to 21 days old.	The period from 22 days of age to 42 days of age.
Yellow Corn %	57.94	53.3
Soybean %	31.6	35.2

Bran %	2.96	4
Limestone %	1	1
Dicalcium %	3	3
Mycotoxin Binder %	1	1
Feed Ingredients	2.5	2.5
Total	%100	%100

* The feed provided to the birds is in the form of pellets (Pellet) produced by Al-Hafez Factory / Private Sector.

Animal Nutrition

The table above illustrates the composition of the feed used in the breeding, and the treatments were distributed as follows: T1 - control diet without additives, T2 - addition of fenugreek powder 2 g/kg, T3 - addition of fenugreek powder 4 g/kg, T4 - addition of thyme powder 2 g/kg, T5 - addition of thyme powder 4 g/kg, T6 - addition of fenugreek powder 1 g/kg and addition of thyme powder 1 g/kg, T7 - addition of fenugreek powder 2 g/kg and addition of thyme powder 2 g/kg. The fenugreek and thyme plants (vegetative group) were purchased from local markets in the holy province of Karbala. Three birds from each treatment were slaughtered, and tests were conducted on them.

Average Weekly Live Body Weight:

Chicks were weighed at one day of age, and the birds were weighed weekly for each replicate of the experimental treatments throughout the experiment, weighing each replicate (10 birds/weight) using an electronic scale during the first three weeks. A scale with a capacity of 50 kg was then used for the last two weeks of the experiment. The following equation was applied to determine the average live weight of the birds within each replicate, as mentioned.

$$\text{Average live weight (g)} = \frac{\text{Total weight of birds in the replicate}}{\text{Total number of birds in the replicate}}$$

Average Weekly Weight Gain:

The weekly weight gain was calculated using the following equation provided by [8].

Weight Gain (g) = Live Body Weight at the End of the Period - Live Body Weight at the Beginning of the Period.

Weekly Feed intake:

The amount of feed consumed each week was calculated by weighing the amount of feed remaining at the end of the period and subtracting it from the total amount provided during the period, according to the equation stated in [8]:

Weekly Feed intake (g) = Feed Provided at the Beginning of the Period - Feed Remaining at the End of the Period.

Feed Conversion Ratio:

According to the weekly feed conversion ratio as reported by [8], the following equation is used:

$$\text{Food conversion factor} = \frac{\text{Average amount of feed consumed per week (g)}}{\text{Average weekly weight gain (g)}}$$

Statistical Analysis

The data were statistically analyzed using the SPSS program following a completely randomized design (CRD) with 10 replicates for each group. Differences between the means were examined using LSD tests, and statistical significance was determined at the $P \leq 0.05$ level.

Results and Discussion

Effect of Using Fenugreek and Thyme Powder on the Weekly Live Body Weight of Broilers

Table 2 illustrates the effect of using fenugreek and thyme powder on the weekly and final live body weight of broilers. There were no significant differences among all experimental treatments during the first week of the chicks' age. In the second week, treatment T2 showed a significant advantage over the control group and the other additive treatments. However, there were no significant differences among the additive treatments T2, T3, T4, T5, T6, and T7, all of which outperformed the control treatment. In the third week, a significant difference ($P \leq 0.05$) was observed for all additive treatments compared to the control treatment, while no significant differences were found between the additive treatments T3, T6, T7 and T2, T4, T5, in relation to the control treatment. In the fourth, fifth, and sixth weeks, significant differences ($P \leq 0.05$) were noted for the additive treatments T2, T4, T5, and T6 over the control treatment and the other additive treatments. No significant differences were observed between T4 and T2, T5, or between T6 and T3, nor was there a significant difference between treatment T7 and the control treatment. A significant difference was noted in the final body weight in favor of treatment T2, which achieved a final weight of 2621.33 g, while the control treatment recorded a lower final weight of 2420.67 g.

Table (2): Effect of adding fenugreek and thyme powder on the weekly body weight (gm) of broiler chickens ± standard error

treat-ments	Age in Weeks					
	1	2	3	4	5	6
T1	0.72± 128.17	1.69±306.33 c	0.87±648.00 b	4.14±1131.17 c	0.88± 1707.83 c	4.33± 2420.67 c
T2	1.69± 132.17	1.04±348.00 a	2.64±736.00 a	17.48±1311.33 a	62.81±1909.50 a	47.23±2621.33 a
T3	1.76± 142.83	3.94± 320.33 b	3.48± 704.67 ab	28.74± 1236.50 b	19.31± 1772.67 bc	6.26± 2465.50 bc
T4	3.51± 138.50	1.48± 332.67 b	3.63±721.83 a	3.41± 1274.17 ab	2.40± 1862.83 ab	4.36± 2539.50 ab
T5	1.42± 140.67	8.41±321.67 b	45.19±718.83 a	3.46±1248.00 ab	15.17±1882.83 a	30.08±2632.00 a
T6	2.68± 140.67	1.04± 331.00 b	27.46± 690.67 ab	2.36± 1169.83 b	39.59± 1827.67 ab	23.17± 2533.50 abc
T7	1.17± 139.67	6.52± 329.50 b	8.74±704.50 ab	32.17± 1169.83 c	9.96± 1728.67 c	70.50± 2436.00 bc
Level of Signifi-cance	N.S	*	*	*	*	*

N.S. indicates no significant differences between the group means.
* Different letters within the same column indicate significant differences between the groups at a significance level of 0.05.

Effect of Using `Fenugreek and Thyme Powder on Weekly Weight Gain Rate of Broilers

Table 3 illustrates the effect of using fenugreek and thyme powder on the weekly and cumulative weight gain rates of broilers. We observe that there are no significant differences during the first, third, fifth, and sixth weeks. However, in the second week, there is a significant improvement ($P \leq 0.05$) in favor of treatment T2 compared to the control treatment and other additive treatments. Meanwhile, there is no significant difference between treatments T5, T6, T7 and treatment T4, as well as between the control treatment and treatment T3. In the fourth week, a significant advantage was noted for the additive treatments T2, T5, and T6 over the control treatment and other additive treatments, while there is no significant difference between the control treatment and T3, T4, and between treatments T2, T5, T6, and treatment T7. When observing the cumulative weight gain, a significant advantage was seen for additive

treatments T2 and T5, while there is no significant difference between treatments T4, T6, and treatments T2, T5, as well as between T3 and T7. Treatment T5 achieved the highest cumulative weight gain (2592.43 g), while the control treatment had the lowest weight gain (2380.87 g).

Table (3): Effect of Adding Fenugreek and Thyme Powder on the Weekly Weight Gain Rate (gm) of Broilers ± Standard Error

treatments	Age in Weeks						Cumulative Weight Gain
	1	2	3	4	5	6	
T1	1.01± 88.37	1.64±178.17 c	0.92±341.67	3.52±483.17 ab	4.93± 576.67	5.20± 712.83	4.79± 2380.87 c
T2	1.61± 91.93	1.92±215.83 a	1.89±388.00	17.53±575.33 a	46.97±598.17	18.81±711.83	47.21±2581.10 a
T3	1.82± 102.33	5.63± 177.50 c	6.83± 384.33	32.06± 531.33 ab	35.02± 536.17	21.73± 692.83	6.26± 2425.00 bc
T4	3.49± 98.67	2.08± 194.17 b	3.67±389.17	5.36± 552.33 ab	1.30± 588.17	3.81± 677.17	4.26± 2499.67 ab
T5	1.66± 101.10	7.00±181.00 bc	43.80±397.17	46.43±574.33 a	14.05±589.67	44.39±749.17	29.86±2592.43 a
T6	2.22± 100.63	2.84± 190.33 bc	28.47± 359.67	29.75± 557.33 a	41.54± 579.67	21.66± 705.83	22.83± 2493.47 abc
T7	0.72± 99.67	7.09± 189.83 bc	6.42±375.00	28.90± 465.33 b	42.11± 558.83	60.94± 707.33	70.50± 2396.00 bc
Level of Significance	N.S	*	N.S	*	N.S	N.S	*

N.S. indicates no significant differences between the group means.

* Different letters within the same column indicate significant differences between the groups at a significance level of 0.05.

Effect of Using Fenugreek and Thyme Powder on Weekly and Cumulative Feed Intake Rates of Broilers

Table 4 shows the effect of using fenugreek and thyme powder on the weekly and cumulative feed consumption rates of broilers. There were no significant differences among all experimental treatments during the first and fifth weeks. In the second week, a significant decrease ($P \leq 0.05$) in feed consumption was observed for treatments T6 and T7 compared to the control treatment and the other additive treatments.

However, there was no significant difference between the control treatment and treatments T5 and T3, nor between treatments T6 and T7. In the third and fourth weeks, a significant decrease ($P \leq 0.05$) was noted for the additive treatments T6 and T3, with no significant difference between the control treatment and additive treatments T2, T5, and T7, as well as between treatment T4 and treatments T3 and T6. In the sixth week, a significant decrease was observed for treatments T5 and T2. Meanwhile, there was no significant difference among treatments T3, T4, T6, and T7, nor between treatments T2 and T5, compared to the control treatment. Regarding cumulative feed consumption and loss, a significant decrease was noted for additive treatments T3, T6, and T7 compared to the control and other additive treatments, with no significant differences between T2, T4, T5, and the control treatment, and between T3, T6, and T7.

Table (4): Weekly feed intake rate (gm) for broilers ± standard error

treatments	Age in Weeks						Cumulative Feed Consumption
	1	2	3	4	5	6	
T1	0.57 ± 108.00	11.42±251.17 bc	25.83±565.33 ab	6.30±851.83 ab	1.18± 1118.03	1.17± 1285.33 a	41.61± 4179.70 a
T2	0.50 ± 106.00	7.42±287.33 a	25.65±530.67 ab	11.55±816.67 ab	52.75±1071.33	21.54±1186.17 b	35.40±3998.17 abc
T3	0.44 ± 101.17	7.42± 257.17 bc	14.73± 552.33 ab	9.04± 774.00 b	100.04± 965.00	19.86± 1190.67 ab	127.88± 3840.33 c
T4	1.89 ± 103.50	6.07± 263.67 b	3.91±609.17 a	58.06± 870.67 a	3.81± 1067.50	41.63± 1177.00 ab	71.90± 4091.50 ab
T5	0.92 ± 106.67	1.92±251.67 bc	15.73±604.17 ab	7.55±841.33 ab	53.83±1013.17	36.82±1232.00 b	56.50±4049.00 abc
T6	1.01 ± 106.	7.53± 263.17 b	31.75± 515.50 b	5.19± 808.83 ab	41.10± 972.00	16.62± 1207.00 ab	61.80± 3872.67 bc

	17						
T7	1.92 ± 104. 83	5.35± 237.83 c	48.99±59 3.00 ab	21.97± 802.33 ab	24.37± 974.67	38.94± 1205.67 ab	41.74± 3918.33 bc
Level of Signifi-cance	N.S	*	*	*	N.S	*	*

N.S. indicates no significant differences between the group means.
* Different letters within the same column indicate significant differences between the groups at a significance level of 0.05.

Effect of Using Fenugreek and Thyme Powder on Weekly and Cumulative Feed Conversion Ratios of Broiler Chickens

Table 5 illustrates the effect of using fenugreek and thyme powder on the weekly and cumulative feed conversion ratio of broiler chickens. It was observed that there were no significant differences (P≤0.05) among all experimental treatments in the first, third, fifth, and sixth weeks. However, in the second week, a significant superiority (P≤0.05) was noted for treatments T7, T6, T5, T4, and T2 over the control group and treatment T3. There were no significant differences between treatments T2, T4, T5, T6, and treatment T7 on one side, and between the control group and treatment T3 on the other side. In the fourth week, a significant superiority was observed in favor of the addition treatments T2, T3, T4, T5, and T6 over the control group and treatment T7. In terms of cumulative feed conversion ratios, all additional treatments recorded better performance compared to the control group, with no significant differences among all additional treatments.

Table (5): Weekly Feed Conversion Ratio (gm feed intake/gm weight gain) for Broiler Chickens ± Standard Error

treatments	Age in Weeks						Feed Conversion Ratio
	1	2	3	4	5	6	
T1	0.019± 1.222	0.066±1. 410 b	0.078±1. 654	0.016±1.7 63 c	0.018± 1.939	0.011± 1.803	0.018± 1.755 b
T2	0.022± 1.153	0.024±1. 330 ab	0.065±1. 367	0.032±1.4 21 a	0.070±1.8 00	0.056±1.66 8	0.016±1.5 493 a
T3	0.021± 0.989	0.060± 1.451 b	0.036± 1.437	0.090± 1.466 ab	0.173± 1.806	0.076± 1.723	0.053± 1.583 a
T4	0.018±	0.021±	0.008±1.	0.098±	0.009±	0.058±	0.026±

	1.050	1.357 ab	565	1.575 abc	1.815	1.738	1.636 a
T5	0.008± 1.055	0.057±1. 394 ab	0.135±1. 551	0.129±1.4 85 abc	0.130±1.7 23	0.051±1.65 0	0.011±1.5 61 a
T6	0.022± 1.055	0.027± 1.382 ab	0.111± 1.444	0.091± 1.461 ab	0.122± 1.690	0.077± 1.714	0.020± 1.553 a
T7	0.026± 1.082	0.025± 1.254 a	0.159±1. 586	0.089± 1.734 bc	0.185± 1.772	0.102± 1.722	0.031± 1.637 a
Level of Sig- nifi- cance	N.S	*	N.S	*	N.S	N.S	*

N.S. indicates no significant differences between the group means.
* Different letters within the same column indicate significant differences between the groups at a significance level of 0.05.

Effect of Using Fenugreek and Thyme Powder on the Production Efficiency of Broiler Chickens

Table 6 illustrates the effect of using fenugreek and thyme powder on the production efficiency of broiler chickens. It is observed that treatments T2, T3, T5, and T6 significantly outperformed the control treatment (P≤0.05), while the additional treatments T4 and T7 also showed significant superiority (P≤0.05) over the control treatment. However, there was no significant difference between T3, T5, and T6 compared to T2, nor between T4 and the others.

Table (6): Effect of Using Fenugreek and Thyme Powder on the Production Efficiency of Broiler Chickens

treatments	Nutritional Conversion Rate
T1	3.86± 328.37 d
T2	11.53±403.01 a
T3	12.40± 371.50 abc
T4	5.46± 369.59 bc
T5	5.36±401.27 ab
T6	6.42± 388.52 ab
T7	16.80± 354.90 cd
Level of Morality	*

N.S. indicates no significant differences between the group means.
* Different letters within the same column indicate significant differences between the groups at a significance level of 0.05.

The effect of using powdered fenugreek and thyme on the primary and secondary cuts of broiler chicken carcasses

Table 7 shows the effect of using powdered fenugreek and thyme on the primary and secondary cuts of broiler chicken carcasses. It is observed that there is a significant difference (P≤0.05) in the relative weight of the primary cuts favoring the addition treatment T5 compared to the control treatment and the other addition treatments. However, there is no significant difference between the addition treatment T7 and the treatments T3 and T4 on the one hand, and the control treatment on the other hand. Additionally, there is no significant difference between the addition treatment T4 and treatment T2 on the one hand, and the addition treatments T6 and T7 on the other hand.

On the other hand, a significant difference (P≤0.05) was observed in the relative weight of the secondary cuts for the control treatment compared to all addition treatments. There is no significant difference between the addition treatments T2, T3, T5, and T6 compared to T4 on the one hand, and treatment T7 on the other hand. Similarly, there is no significant difference between T7 and the control treatment on the one hand, and the treatments T3, T4, and T6 on the other hand.

Table (7): The effect of using powdered fenugreek and thyme on the primary cuts of broiler chicken carcasses ± standard error

treatments	Relative Weight of the Breast	Relative Weight of the Thigh	Relative Weight of the Neck	Relative Weight of the Back	Relative Weight of Wings
T1	±31.3160.425 d	± 26.159 0.172 f	5.3160.031 ± a	26.725 ±0.307 a	±10.4510.028 a
T2	34.678± 0.238 b	28.044± 0.133 b	4.257 ± 0.032 bc	23.771 ± 0.200 c	9.203 0.027 ± f
T3	32.637 ± 0.335 c	± 27.091 0.146 d	4.953 ± 0.040 bc	25.401 ± 0.350 b	9.879 ± 0.030 c
T4	33.373 ± 0.219 c	27.755 ± 0.113 bc	4.566 ±0.054 b	24.771 ± 0.175 b	9.5040.032 ± e
T5	35.890± 0.515 a	28.994± 0.073 a	0.033 ±4.112 bc	21.856 ± 0.494 d	9.1060.018 ± f
T6	33.135 ± 0.260 b	27.582 ± 0.060 c	4.6530.028 ± bc	24.943 ± 0.229 b	9.6540.045 ± d
T7	32.337± 0.340 cd	26.641± 0.066 e	5.1030.023 ± c	25.827 ± 0.403 ab	10.053 ± 0.035 b

Level of Morality	*	*	*	*	*

N.S. indicates no significant differences between the group means.
* Different letters within the same column indicate significant differences between the groups at a significance level of 0.05.

The effect of using fenugreek and thyme powder on the dressing percentage with or without edible offal in broiler carcasses is shown in Table 8. There is a significant difference (P≤0.05) in the hot carcass weight and dressing percentage with or without edible offal in favor of the treatments T5 and T2 compared to the control treatment and other addition treatments. However, there is no significant difference between the addition treatments T4 and T6 compared to T2 and T5 on one side, and T3 and T7 on the other side. Additionally, there is no significant difference between the addition treatments T3 and T4 compared to T2 and T5 on one side, and T7, T6, and the control treatment on the other side. There is also no significant difference between the addition treatments T2, T4, and T6 compared to treatment T5 on one side, and T3 on the other side.

When observing the relative weight of the heart, a significant difference (P≤0.05) was seen in favor of T2 and T5 compared to the control treatment and other addition treatments. There is no significant difference between the addition treatments T3, T4, and T7 compared to T2 and T5 on one side, and T6 and the control treatment on the other side. For the relative weight of the liver, a significant difference was observed at (P≤0.05) for the addition treatments T2 and T5 compared to the control treatment and other addition treatments, with no significant difference between T3 and the addition treatments T4 and T6 on one side, and treatment T7 on the other side. A significant difference (P≤0.05) was noted in the relative weight of the gizzard in favor of T5 compared to the control treatment and the other addition treatments, with no significant difference observed between the addition treatment T7 and the control treatment.

The effect of using fenugreek powder and thyme on the yield percentage with or without edible offal in broiler poultry carcasses

The effect of using fenugreek and thyme powder on the dressing percentage with or without edible offal in broiler carcasses is shown in Table 8. There is a significant difference (P≤0.05) in the hot carcass weight and dressing percentage with or without edible offal in favor of the treatments T5 and T2 compared to the control treatment and other addition treatments. However, there is no significant difference between the addition treatments T4 and T6 compared to T2 and T5 on one side, and T3 and T7 on the other side. Additionally, there is no significant difference between the addition treatments T3 and T4 compared to T2 and T5 on one side, and T7, T6, and the control treatment on the other side. There is also no significant difference between the addition treatments T2, T4, and T6 compared to treatment T5 on one side, and T3 on the other side.

When observing the relative weight of the heart, a significant difference (P≤0.05) was seen in favor of T2 and T5 compared to the control treatment and other addition treatments. There is no significant difference between the addition treatments T3, T4, and T7 compared to T2 and T5 on one side, and T6 and the control treatment on the other side. For the relative weight of the liver, a significant difference was observed at (P≤0.05) for the addition treatments T2 and T5 compared to the control treatment and other addition treatments, with no significant difference between T3 and the addition treatments T4 and T6 on one side, and treatment T7 on the other side. A significant difference (P≤0.05) was noted in the relative weight of the gizzard in favor of T5 compared to the control treatment and the other addition treatments, with no significant difference observed between the addition treatment T7 and the control treatment.

Table (8): Effect of using fenugreek and thyme powder on the secondary cuts of broiler carcasses ± standard error

treatments	Hot carcass weight	Percent clearance without gut eaten	Relative heart weight	Relative liver weight	Relative sniper weight	Percent clearance with gut eaten
T1	1475.67 ± 3.48 c	60.961 ± 0.038 b	0.390 ± 0.013 b	1.445 ± 0.013 d	1.526 ± 0.004 f	64.324 ± 0.691 c
T2	1673.33 ± 28.91 a	63.836± 0.057 a	0.432 ±0.049 a	1.608 ± 0.001 a	1.710 ± 0.004 b	67.588 ± 0.309 ab
T3	1531.67 ± 7.26 bc	62.123 ± 0.170 ab	0.421 ± 0.006 ab	1.500 ± 0.003 bc	1.556 ± 0.006 e	65.601 ± 0.104 bc
T4	1592.67 ±4.63 ab	62.715 ± 0.135 ab	0.426 ± 0.001 ab	1.520 ± 0.001 b	1.639 ± 0.005 c	66.301 ± 0.555 abc
T5	1685.00 ± 18.02 a	64.020± 0.081 a	0.436 ±0.008 a	0.008 ±1.620 a	1.755 ± 0.006 a	67.832± 0.202 a
T6	1582.00 ±13.86 abc	62.443 ± 0.037 ba	0.421 ± 0.004 ba	1.517 ± 0.001 b	1.607 ± 0.005 d	65.990 ± 0.355 abc
T7	1511.33 ± 82.73 bc	61.946± 1.652 ba	0.411 ±0.013 ab	1.482 ± 0.004 c	1.536 ± 0.001 f	65.376± 0.392 c
Level of Morality	*	*	*	*	*	*

N.S. indicates no significant differences between the group means.
* Different letters within the same column indicate significant differences between the groups at a significance level of 0.05.

Effect of Using Powdered Fenugreek and Thyme on the Relative Length of the Small Intestine (Duodenum, Jejunum, Ileum) and Cecum in Broiler Chickens

Table 9 illustrates the effect of using powdered fenugreek and thyme on the relative length of the small intestine (duodenum, jejunum, ileum) and cecum in broiler chickens. A significant difference (P≤0.05) was observed in favor of treatments T5 and T2 regarding the relative length of the duodenum compared to the control treatment and other additive treatments. However, there was no significant difference between the additive treatment T4 and the additive treatments T2 and T5 on the one hand, and the additive treatment T6 on the other hand.

Regarding the relative length of the jejunum, ileum, and cecum, a significant difference (P≤0.05) was noted in favor of the additive treatment T5 compared to the control treatment and other additive treatments. There was no significant difference between the additive treatments T4 and T6 in the relative length of the ileum. Additionally, no significant difference was found in the relative length of the cecum between the additive treatment T4 and the additive treatment T2 on the one hand, and the additive treatments T7 and T6 on the other hand.

Table (9): Effect of Using Powdered Fenugreek and Thyme on the Relative Length of the Intestines in Broiler Chickens ± Standard Error

treatments	The relative length of the duodenum	Relative Height of Jujenum	Relative Height of Illum	The relative length Secum	Relative Length of the Small Intestine
T1	0.634 ± 0.033 d	2.133 ± 0.056 f	2.294 ± 0.055 f	0.452 ± 0.022 f	5.062 ± 0.092 g
T2	1.102 ± 0.094 a	2.928 ±0.053 b	2.970 ±0.024 b	0.790 ± 0.025 b	7.001 ± 0.132 b
T3	0.880 ± 0.034 c	2.339 ± 0.045 e	2.663 ± 0.015 d	0.629 ± 0.006 d	5.883 ± 0.037 e
T4	1.057 ±0.016 ab	2.799 ± 0.033 c	2.827 ± 0.032 c	0.713 ± 0.032 bc	6.684 ± 0.037 c
T5	1.120 ± 0.037 a	3.102 ±0.061 a	3.190 ±0.047 a	0.012 ±0.892 a	7.413 ± 0.120 a
T6	0.924 ±0.025 bc	2.501 ± 0.018 d	2.801 ± 0.021 c	0.666 ± 0.010 cd	6.226 ± 0.029 d
T7	0.724 ± 0.066 d	2.214 ±0.063 f	2.442 ±0.030 e	0.548 ± 0.045 e	5.3806 ± 0.082 f
Level of Morality	*	*	*	*	*

N.S. indicates no significant differences between the group means.
* Different letters within the same column indicate significant differences between the groups at a significance level of 0.05.

Effect of Using Fenugreek and Thyme Powder on the Relative Weight of the Small Intestine (Duodenum – Jejunum – Ileum) and Caeca in Broiler Chickens

Table 10 shows the effect of using fenugreek and thyme powder on the relative weight of the small intestine (duodenum, jejunum, and ileum) and caeca in broiler chickens. It is observed that there is a significant superiority (P≤0.05) for the treatment T5 in the relative weight of the small intestine and its parts (duodenum, jejunum, and ileum) and caeca compared to the control group and the other treatments. However, there is no significant difference in the relative weight of the caeca among the treatments T3, T4, and T6.

Table (10): Effect of using fenugreek and thyme powder on the relative weight of the small intestine (duodenum, jejunum, and ileum) and ceca in broiler chickens ± standard error

treatments	The relative weight of the dupdenum	The relative weight of jujenum	The relative weight of Illum	The relative weight of Secum	The relative weight of the small intestine
T1	0.618 ± 0.010 g	0.953 ± 0.019 g	1.009 ± 0.013 g	0.507 ± 0.019 e	2.580 ± 0.015 g
T2	0.967 ± 0.008 b	1.762± 0.037 b	1.887 ±0.039 b	0.815 ± 0.017 b	4.617 ±0.041 b
T3	0.745 ± 0.018 e	1.189 ± 0.014 e	1.299 ± 0.024 e	0.669 ± 0.007 c	± 3.234 0.019 e
T4	0.878 ±0.010 c	1.517 ± 0.032 c	1.629 ± 0.027 c	0.705 ± 0.006 c	± 4.0250.032 c
T5	1.052 ± 0.013 a	1.913± 0.034 a	2.086 ±0.056 a	0.010 ±0.889 a	± 5.0520.077 a
T6	0.807 ±0.005 d	1.349 ± 0.011 d	1.409 ± 0.016 d	0.698 ± 0.007 c	3.566 ± 0.017 d
T7	0.667 ± 0.011 f	1.102± 0.002 f	1.114 ±0.006 f	0.597 ± 0.007 d	2.884 ± 0.019 f
Level of Morality	*	*	*	*	*

N.S. indicates no significant differences between the group means.
* Different letters within the same column indicate significant differences between the groups at a significance level of 0.05.

The results of Tables 2,3 indicate a significant superiority (P≤0.05) in the final body weight and total weight gain for the treatments with the addition of fenugreek powder and thyme powder compared to the control treatment. This is attributed to the improvement in the rate of feed consumption and the enhancement of the feed conversion ratio, as shown in Tables 6,7, which positively reflects on the final body weight and weekly weight gain. This may be due to improved digestibility and nutrient absorption resulting from the presence of Saponins, which stimulate the hypothalamus gland, in turn encouraging increased feed intake, as Saponins enhance the activity of the digestive system [9].

Additionally, this improvement is attributed to the beneficial effects on the digestive system and the ability to modify the intestinal texture due to the active compounds in fenugreek and thyme, which act as antibacterial agents against pathogenic bacteria and promote beneficial bacteria such as Lactobacilli over harmful bacteria like E. Coli, as the beneficial bacteria produce lactic acid that inhibits the activity of pathogenic bacteria. The presence of fatty acids in fenugreek leaves also acts as an antibacterial and antifungal agent [10].

Moreover, the improvement in growth rate, weight gain, and final body weight is attributed to the presence of active phenolic compounds (Thymol and Carvacrol) in thyme, which enhance the activity of digestive enzymes and thus improve the feed conversion ratio, positively reflecting on body weight and weight gain. Thyme can improve digestion by promoting bile salt secretion, increasing the activity of digestive enzymes, and enhancing the intestinal mucosal development, which contributes to weight gain and improved feed conversion ratio [10].

The results in Tables 4, 5 indicate a significant superiority (P≤0.05) in the feed consumption rate and overall feed conversion ratio for all treatments with the additions of fenugreek powder and thyme compared to the control group. This is also attributed to achieving significance in final body weight, cumulative weight gain, and production performance, as shown in Tables 2, 3, resulting from the improvement in the feed conversion ratio and total feed consumption. The presence of proteins, fats, carbohydrates, and minerals such as calcium, phosphorus, iron, zinc, and magnesium found in fenugreek [11], along with the presence of fatty acids and their stimulating effect on the digestive system of broiler chickens [10,12], is also significant. Additionally, the incorporation of fenugreek powder into the feed for broiler chickens has significantly improved live body weight and weekly weight gain by enhancing the digestibility and absorption of nutrients. This is due to the presence of saponins, which activate the hypothalamic gland, stimulating increased feed intake, which in turn enhances digestive system function [9].

Moreover, the addition of fenugreek powder to the broiler chicken diet has achieved significant superiority in weight gain and total body weight, as well as an improvement in the feed conversion ratio, due to increased digestive system activity

and its ability to modify intestinal tissue by increasing the weight and relative length of the small intestine and its villi, thereby enhancing the surface area for nutrient absorption. This aligns with the findings of [12].

The improvements in feed consumption and feed conversion ratio can be attributed to the presence of fatty acids found in fenugreek leaves added to poultry feed. The active compounds in fenugreek act as antifungal and antibacterial agents, as well as anti-inflammatory and antioxidant substances, which enhance live body weight, weight gain, and feed conversion ratio [10]. Additionally, the inclusion of thyme powder resulted in a significant improvement ($P \leq 0.05$) in feed consumption and overall feed conversion ratio due to a noticeable reduction in pathogenic intestinal bacteria and an increase in the height of villi in the intestines, which enhances the surface area for absorption. This aligns with the opinion of [13]. It may also be attributed to increased digestive tract activity due to improved mucosal function, which enhances digestion and increases nutrient utilization from feed. This is consistent with the view of [14].

Table 6 indicates a significant superiority of all additive treatments in the values of the production index compared to the control treatment. This is attributed to the substantial improvement in additive treatments regarding cumulative feed conversion ratio, feed consumption rate, and achieving significance in cumulative body weight and cumulative weight gain, as shown in Tables 2-5. Additionally, there were no mortalities, resulting in a 100% viability rate, which positively reflects on the values of the production index. This aligns with the findings of [4].

The significant superiority in the relative weight of the main cuts in the addition treatments compared to the control treatment can be attributed to the significant superiority in final body weight, cumulative weight gain, improvements in feed conversion efficiency, and feed consumption rate, which positively reflect on the weight of the main cuts. There is a direct relationship between body weight and dressing percentage, as well as between body weight and the main cuts. However, as observed in the table above, the control treatment shows significant superiority over all addition treatments in the relative weight of the secondary cuts. This is attributed to the significant superiority in the relative weight of the main cuts in favor of all addition treatments, which negatively affects the relative weights of the secondary cuts (neck, back, and wings), leading to a decrease in the relative weights of the secondary cuts [4].

The significant superiority at the level of ($P \leq 0.05$) in favor of the additive treatments over the control treatment in terms of the dressing percentage, with or without edible offal, can be attributed to the fact that the dressing percentage has a positive indicator due to the significant improvement in final body weight and weight gain, as well as in all production traits, as shown in Tables (5, 6, 10). Additionally, the significant improvement in the feed conversion ratio and feed consumption rate positively reflects on the dressing percentage, as illustrated in Tables 4 and 5. The relative

weights of the edible offal (heart, liver, and gizzard) significantly surpassed those of the control treatment due to the improvement in metabolic processes and increased liver enzyme activity in the additive treatments, as shown in Table 15. This positively affects the relative weight of the heart and liver due to improvements in metabolic processes, which in turn increase the relative weight of the liver and gizzard. The improvement in metabolic processes is a result of the increased size and relative weight of the organ responsible for metabolic processes, which is the liver [4].

Tables 10-9 demonstrate a significant superiority in the length and relative weight of the parts of the small intestine (duodenum, jejunum, ileum) and ceca in the addition treatments compared to the control treatment. This is attributed to the inclusion of added herbaceous plants in the diet, which contain soluble fibers that enhance intestinal movement and improve digestion. The active compounds present in these plants help form a protective membrane in the intestinal lining, aiding in the protection of intestinal cells and improving the thickness and integrity of the intestinal lining, which contributes to better nutrient absorption. The addition of fenugreek powder to the chicken diet alters the morphology of the intestine by increasing the height of the villi and the depth of the crypts, which reduces pathogenic microorganisms in the digestive system, thereby decreasing damage to the epithelial intestinal cells and increasing the number of absorptive cells. This positively affects the intestinal health and immunity in meat chickens [15].

Thyme may act as a digestive enhancer by balancing the microbial ecosystem of the intestine and stimulating the secretion of digestive enzymes, leading to an improved microbial environment. Consequently, this results in increased secretion of certain organic acids, such as tartaric acid, which helps maintain the acid-base balance in the digestive tract and inhibits the activity of pathogenic bacteria in the intestine. This positively reflects on the weight and relative length of the small intestine and its parts, as thyme powder added to chicken diets has significantly increased the length of the villi and the depth of the crypts, as well as the thickness of the intestinal membrane [16].

The addition of fenugreek and thyme powder to broiler chicken feed at different levels leads to a significant improvement in some productivity and physiological parameters, consequently enhancing growth standards and feed conversion efficiency. Therefore, we recommend using fenugreek and thyme powders, either individually or in combination, at known and studied levels to be added to broiler chicken feed.

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