

Impact of Using Locally Shiitake Mushroom (*Lentinus Edodes*) Waste Powder on Productive Performance of Brown Laying Hens

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ABSTRACT

This study was conducted the field of the Poultry Research Station of the animal resources Dep./ office of Agricultural Research / Ministry of Agriculture from 27th June, to 17th October 2024. The study was aimed to determine the effect of using different levels of locally shiitake mushroom waste powder in the diet of laying, with or without the addition of probiotics, on the productive performance of the chickens. The used 135 ISA Brown laying 20-week aged were used in the experiment, distributed into nine treatments, each containing three replicates, each containing five hens. The treatments were as follows: Control treatment T1: the basic diets. Treatments T2, T3, T4, T5 used shiitake mushroom waste in a percentage of 2, 4, 6, and 8%, respectively. Treatments T6, T7, T8, T9 used shiitake mushroom waste in the same percentages, respectively, with the addition 0.05% of probiotics. The results showed highly increasing significant ($P \leq 0.01$) egg production percentage (H.D%) in treatments T7, T2 compared with T9, T8, T4, and T1 in the total period (22-37) weeks. the cumulative number of eggs, the results indicated that treatments T9, T7, T6, T5, T3, and T2 significantly compared with the control treatment T1 over the total period for this trait. The results showed a significant ($P \leq 0.01$) improvement in the egg mass for treatments T3 and T2 compared with T8, T6, T4, and T1. The feed conversion ratio significant ($P \leq 0.01$) improvement for treatments T7, T3, and T2 over the control treatment T1 over the total period.

Key words: Cumulative number of eggs, Egg mass, ISA Brown, Probiotic.



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INTRODUCTION

The poultry industry is one of the pillars of global food security, as it relies on it to provide eggs and white meat to meet growing food needs. to their high nutritional value, protein, and energy (Pernet and Ribi, 2019). The poultry industry has suffered from numerous problems recently due to rising feed costs, and fluctuating market prices for eggs and meat. These problems must be addressed to make the poultry sector a sustainable enterprise. Success in poultry production depends on several factors, the most important of which is the provision of good quality feed, which is the most expensive component in the poultry industry. Providing less expensive feed

alternatives such as vegetable oils rich in active compounds and antioxidants may enable us to produce functional meat with high nutritional value and health benefits for humans, thus improving the productive performance of chickens (Tanjung et al, 2025). To alleviate this, research is being done to find alternative sources to fill the shortage of feed materials, including the use of recycling agricultural waste to produce unconventional feed. The agricultural sector contributes significantly to the production of these wastes worldwide, and improper management of these wastes can cause environmental pollution (Antunes et al, 2020; Mishra and Satapathy, 2021; Kani et al, 2022). Agricultural wastes

are a good source of nutrients for mushroom production because they support the growth of food fungi and their development into fruiting bodies of mushrooms. The most commercially used agricultural wastes for the production of edible mushrooms include wheat bran, cottonseed husks, sawdust, corn cobs (Chiu et al, 2000; Sath et al, 2018; Guo et al, 2022). When mushrooms are harvested, these wastes are considered the spent growing substrate and are referred to as “spent mushroom substrate (SMS).” Approximately 5 kg of waste substrate is produced from the growth and production of 1 kg of mushrooms (medina et al,2012). Interest in the cultivation of edible mushrooms has increased significantly due to their high ability to decompose cellulosic materials, which facilitates their cultivation on inexpensive agricultural waste, as process due to their high protein content resulting from the presence of mycelial biomass and low fiber content (Klaus and Wan, 2022 ;Farhan and Chechan, 2023). In recent years, researchers in the field of animal nutrition, including poultry, have turned to searching for alternative feed sources that pose no health risks to birds and improve and increase production (Laudadio et al, 2015; Dhama et al, 2015). The nutritional value of fleshy mushroom waste is affected by several factors, including the mushroom species, environmental conditions, and the type of growth media (Borah et al,2019). Probiotics are a group of live microorganisms that can be added to feed as natural additives due to their beneficial effects on the intestines. They improve digestibility, increase enzyme activity, and improve intestinal morphology (Suryadi et al, 2019; Ding et al, 2021), which increases the surface area exposed to nutrient absorption. They also improve metabolism (Adriani et al, 2021), thus positively improving the productive performance of laying hens. These effects are due to the probiotics containing *Lactobacillus*, *Bifidobacterium*, *Streptococcus*, and others

(Dai et al, 2022; Krismiyanto et al, 2022). The aim of this study is to conduct a comprehensive evaluation of the agricultural waste of local shiitake mushrooms before and after cultivation on a bran mixture. Wheat and corn cobs were used in an attempt to improve the nutritional value of these wastes and conduct a chemical analysis (approximate analysis) to reveal the type and concentration of active ingredients and to detect their mycotoxin content, if present, and then use the powder of these wastes in different proportions with and without probiotics in the feed of laying hens to study their effect on the productive performance of laying hens.

MATERIALS AND METHODS

This study included two experiments, one laboratory and the other field. The first (laboratory) experiment: Collection of local shiitake mushroom waste: The remaining growth media waste was collected after cultivating local shiitake mushrooms on wheat bran and corn cobs, and after harvesting the fruiting bodies for the 2023 agricultural season. The media was dried and ground and stored in bags in suitable locations pending the study's experiments.

Laboratory tests of growth media waste: A preliminary chemical analysis was conducted before and after growing shiitake mushrooms to determine the nutritional value of these wastes in the laboratories of the Scientific Research Authority/Environment and Water Research Center, as shown in Table 1. Mycotoxin tests were also conducted in the laboratories of the Quality Control Department /Animal Resources Department/ Ministry of Agriculture, as shown in Table (2), on feed additives provided to birds. These additives included powdered local shiitake mushroom waste, represented by corn cobs and wheat bran, after growing shiitake mushrooms on them, to determine the type of mycotoxins and their concentration within permissible limits, if any.

Table 1. Chemical analysis of local shiitake mushroom waste powder

Ingredients	Before development (%)	After development (%)
Protein	14.08	18.18
Fat	3.78	4.87
Ash	7.45	9.25
Moisture	8.99	5.11
Fiber	32.00	12.25
Carbohydrates	33.70	50.34
Kcal / Kg Energy	3541	3665

Table 2. Type and concentration of mycotoxins in local shiitake mushroom waste powder

Mycotoxi	concentration PPb	Permissible limits PPb
Aflatoxin	1.0	20
T-2 HT-2	0.0	100
Ochratoxin	0.0	5
Fumonisin	0.6	10
Deoxynivalenol	1.5	8

Tests were also conducted on local shiitake mushroom waste powder to determine the type and percentage of active compounds in this waste, as shown in Table (3).

Table 3. Active compounds of local shiitake mushroom waste powder

Name	Con
Total phenolic content (mg /100 gm)	412.5
Total flavonoid content (mg /100 gm)	256.9
Total alkaloid content %	5.49
Total glycoside content %	3.65
Total tannin content %	2.99

Analyses were also conducted to determine the type and percentage of amino acids in the local shiitake mushroom waste powder, as shown in Table (4).

Table 4. Type and percentage of amino acids in the local shiitake mushroom waste powder

Compound Name	Amount (µg/gm)
Lucien	60.25
Histidine	56.98
Methionine	55.79
Isoleucine	50.14
Proline	47.77
Lysine	45.15
Cysteine	40.98
Arginine	35.29
Threonine	33.65
Tyrosine	32.56
Asparagine	30.98
Phenylalanine	28.99
Serine	28.98
Valine	24.78
Aspartic acid	22.89
Alanine	16.48

Second experiment (field): This study was conducted at the Abu Ghraib Poultry Research Station, affiliated with the Agricultural Research Department/ Ministry of Agriculture. The field experiment lasted 16 weeks, from June 27, 2024, to October 1, 2024. Laboratory tests of the eggs produced followed the completion of the field experiment, which

studied the effect of using powdered local shiitake mushroom growth residues grown on corn cobs and wheat bran, with or without the addition of probiotics to the feed of laying hens, and its impact on production performance. 135 laying hens Brown ISA 20-week-old were used in the experiment. The hens were raised using a cages system, with

one hens per cage, distributed among nine treatments, each containing three replicates, and each replicate containing five hens. The experiment lasted 16 weeks, divided into four field experiment periods, each four weeks long. In this study, four different levels of shiitake mushroom waste powder were used with and without adding probiotics to the laying hens' feed. The production feed was prepared by crushing and mixing the feed components according to the required proportions, as shown in Table (5). Local shiitake mushroom waste was weighed according to its use in the feed. The treatments were as follows:

Treatment 1: Base diet without waste

Treatment 2: Base diet with 2% local shiitake mushroom waste powder

Treatment 3: Base diet with 4% local shiitake mushroom waste powder

Treatment 4: Base diet with 6% local shiitake mushroom waste powder

Treatment 5: Base diet with 8% local shiitake mushroom waste powder

Treatment 6: Base diet with 2% local shiitake mushroom waste powder + 0.05 % probiotic

Treatment 7: Base diet with 4% local shiitake mushroom waste powder + 0.05% probiotic

Treatment 8: Base diet with 6% local shiitake mushroom waste powder + 0.05% probiotic

Treatment 9: Base diet with 8% local shiitake mushroom waste powder + 0.05% Probiotic

Table 5. Percentages of feed components used in the study and their calculated chemical composition

Ingredients %	Treatment ¹				
	T1	T2+T6	T3+T7	T4+T8	T5+T9
Yellow Corn	31	30	21	24	22.5
Wheat	31	31	39	34.5	34
Soybean Meal ²	24.25	23.55	22.5	22.25	22
Premix ³	2.5	2.5	2.5	2.5	2.5
Mushroom Waste Powder ⁴	-	2	4	6	8
Vegetable Oil	1.25	0.95	1	0.75	1
Dicalcium Phosphate	1	1	1	1	1
Limestone	8.5	8.5	8.5	8.5	8.5
Salt	0.1	0.1	0.1	0.1	0.1
Methionine	0.2	0.2	0.2	0.2	0.2
Lysine	0.2	0.2	0.2	0.2	0.2
Total	100	100	100	100	100
Calculated Chemical Composition ⁵					
M.E. (kcal/kg Feed)	2734.90	2730.62	2730.90	2735.70	2759.55
Crude Protein (%)	18.35	18.29	18.39	18.32	18.38
Crude Fiber (%)	2.6	2.8	3	3.1	3.4
Crude Fat (%)	3.5	3.2	3.2	3.2	3.4
Lysine (%)	1.11	1.08	1.06	1.04	1.03
Methionine + Cysteine (%)	0.81	0.80	0.78	0.77	0.76
Calcium (%)	4.07	4.07	4.06	4.06	4.06
Available Phosphorus (%)	0.54	0.53	0.53	0.53	0.53

Statistical analysis was conducted using a completely randomized design (CRD). Significant differences between means were tested using Duncan's multiple range test by SPSS (2017) was used for analysis to determine the effect of different treatments on studied traits.

⁽¹⁾ T9, T8, T7, and T6 used local shiitake mushroom waste powder at rates of 2, 4, and 8.6%, respectively, with addition 0.05% probiotics in the base feed, and the probiotics each 1 kg contains 2.75*10⁹ cfu

Lactobacillus acidophilus, 8.25*10⁹ cfu Streptococcus faecium, 1.1*10⁹ cfu Bacillus subtilis, 2750 csu protease, 5550 slu Amylase, 275 fpui Celulase

⁽²⁾ The soybean meal used is from an Argentinian source, with a crude protein content of 48% and 2,440 kcal/kg of metabolizable energy. ⁽³⁾ Shiitake mushroom waste powder, crude protein content 16.08%, energy 3683 kcal ⁽⁴⁾ The vitamin and mineral premix used is animal-based, produced by the Jordanian company (imported) Intraco. It contains 8% crude protein, 2% crude fat, 0.50% crude fiber, 20.40% calcium, 9.50% phosphorus, 5.50% sodium, 6.50% chlorine, 0.95% lysine, 2.30% digestible lysine, 5.60% methionine,

5.75% digestible methionine, 5.80% digestible methionine + cysteine, 5.60% methionine + cysteine, 1.60% digestible troponin, and 0.20% digestible tryptophan. ⁽⁵⁾ These ratios were calculated based on NRC(1994).

RESULTS AND DISCUSSION

Table (6) shows the effect of using different percentages of local shiitake mushroom waste powder, with or without the addition of probiotics, in the diet of laying hens on egg production rates. The results indicated no significant differences between the different treatments in the first period (22-25 weeks). In the second period (26-29 weeks), the results showed highly significant differences ($P \leq 0.01$) between the different treatments of the experiment. Treatments T9, T5, and T4 significantly outperformed the rest of the experimental treatments by percentages of 91.43, 91.43, and 91.90%, respectively. Treatments T8, T6, and T2 did not differ significantly from each other or from treatments T7, T3, and T1 during this period. In the third period (30-33 weeks), the results also showed highly significant differences ($P \leq 0.01$) between the different treatments of the experiment. Treatments T9 and T7 significantly outperformed the other treatments. T8, T6, T4, T1 with percentages of 90.48, 89.76% respectively, while treatments

T5, T3, T2 did not differ significantly among themselves and did not differ significantly from treatments T9, T8, T7, T6, T4 in the same period. As for the fourth period (34-37) weeks, the results indicated the presence of highly significant differences $P \leq 0.01$ between the different treatments, as the second treatment T2 significantly outperformed treatments T9, T8, T7, T5, T4, T3, T1 by 94.76%, while treatments T9, T8, T7, T5, T4, T3 did not differ significantly among themselves and did not differ significantly from treatments T6, T1 in the same period for the trait of egg production percentage H.D%. As for the total period (22-37) weeks, the results also showed the presence of highly significant differences ($P \leq 0.01$) between the different treatments of the experiment, as treatments T7, T2 significantly outperformed treatments T9, T8, T4, T1 by 90.24, 91.25% respectively, while treatments T6, T5, T3 did not differ significantly between them and did not differ from treatments T9, T8, T7, T4, T2 as well, while treatments T8, T4 did not differ significantly between them and did not differ from treatments T6, T5, T3, T1 in the same period for the trait of egg production percentage H.D%.

Table 6. The effect of using local shiitake mushroom growth waste powder with or without adding probiotics in the feed of laying hens on the percentage of HD% (mean± stander error)

HD%	HD% period (Weeks)				
	First period 22-25	Second period 26-29	Third period 30-33	Fourth period 34-37	Total period 22-37
T1	80.00±3.60	1.86 ^c 78.10±	77.38± 3.10 ^c	85.24±8.6 ^c	80.18±2.14 ^c
T2	91.19±8.6	89.76±1.45 ^{bc}	89.28±1.80 ^{ab}	94.76±1.45 ^a	91.25±4.5 ^a
T3	89.52±1.56	90.00±4.1 ^b	89.29±4.1 ^{ab}	88.10±1.56 ^{bc}	89.23±8.8 ^{ab}
T4	84.52±8.69	91.90±1.56 ^a	86.91±1.26 ^{bc}	88.33±2.74 ^{bc}	87.92±3.21 ^{bc}
Treatment T5	89.52±6.3	91.43±0.0 ^a	89.53±1.86 ^{ab}	87.38±2.4 ^{bc}	89.47±5.8 ^{ab}
T6	88.33±2.27	89.05±6.3 ^{bc}	88.09±9.5 ^b	91.90±8.6 ^{ab}	89.34±6.9 ^{ab}
T7	91.91±1.45	90.00±1.24 ^b	89.76±8.6 ^a	89.29±3.22 ^{bc}	90.24±6.2 ^a
T8	85.71±1.89	89.76±4.7 ^{bc}	86.91±9.5 ^{bc}	88.81±1.04 ^{bc}	87.80±8.0 ^{bc}
T9	85.00±2.89	91.43±1.80 ^a	90.48±1.32 ^a	88.81±6.3 ^{bc}	88.93±1.03 ^b
Significant	N.S	**	**	**	**

T1: Control treatment: basal diet (residue-free). T2, T3, T4, T5: Use of local shiitake mushroom waste powder at 2, 4, 6 ,and 8%, respectively, in the basal diet. T6, T7, T8, T9: Use of local shiitake mushroom waste powder at 2, 4, 6 , and 8%, respectively, with the addition 0.05% of probiotics to the basal diet. **Statistically significant differences at $P \leq 0.01$. N.S.: Not statistically significant.

Table (7) shows the effect of using different proportions of local shiitake mushroom waste powder with or without adding probiotics in

the feed of laying hens on the cumulative number of eggs. The results indicated that there were no significant differences between

the different treatments in the first period (22-25) weeks. As for the second period (26-29) weeks, the results showed that there were highly significant differences ($P \leq 0.01$) between the different treatments of the experiment. Treatments T9, T5, and T4 significantly outperformed the control treatment T1 by percentages of 6.40, 6.40, and 6.43, respectively. While treatments T8, T7, T6, T3, and T2 did not differ significantly between them and did not differ from the rest of the different experimental treatments in the same period. In the third period (30-33) weeks, the results showed highly significant differences ($P \leq 0.01$) between the different treatments, as treatments T9, T7, T5, T3, T2 significantly outperformed the control treatment T1 by percentages of 6.33, 6.28, 6.27, 6.25, 6.25, respectively, while treatments T8, T6, T4 did not differ significantly between themselves and did not differ from the rest of the different experimental treatments in the

same period. In the fourth period (34-37) weeks, the results indicated the presence of highly significant differences ($P \leq 0.01$) between the different treatments of the experiment, as the second treatment T2 significantly outperformed treatments T9, T8, T7, T5, T4, T3, T1 by a percentage of 6.62, while treatments T9, T8, T7, T5, T4, T3 did not differ significantly between themselves and did not differ significantly from treatments T6, T1 in the same period. As for the total period (22-37) weeks, the results showed the presence of highly significant differences ($P \leq 0.01$) between the different treatments of the experiment, as treatments T9, T7, T6, T5, T3, T2 significantly outperformed the control treatment T1 by percentages of 6.23, 6.32, 6.25, 6.26, 6.25, 6.39, respectively, while treatments T8, T4 did not differ significantly among themselves and did not differ from the rest of the experimental treatments in the same period for the cumulative number of eggs.

Table 7. The effect of using local shiitake mushroom waste powder with or without adding probiotics in the feed of laying hens on the cumulative number of eggs (mean $\pm$ stander error)

cumulative number of eggs		Period (Weeks) egg/bird/weekly				
		First period 22-25	Second period 26-29	Third period 30-33	Fourth period 34-37	Total period 22-37
treatme nt	T1	5.60 $\pm$ 2.5	5.47 $\pm$ 1.3 ^b	5.42 $\pm$ 2.2 ^b	5.97 $\pm$ 0.6 ^c	5.61 $\pm$ 1.5 ^b
	T2	6.38 $\pm$ 0.6	6.28 $\pm$ 1.0 ^{ab}	6.25 $\pm$ 1.3 ^a	6.63 $\pm$ 1.0 ^a	6.39 $\pm$ 0.3 ^a
	T3	6.27 $\pm$ 1.1	6.30 $\pm$ 0.3 ^{ab}	6.25 $\pm$ 0.3 ^a	6.17 $\pm$ 1.1 ^{bc}	6.25 $\pm$ 0.6 ^a
	T4	5.92 $\pm$ 6.1	6.43 $\pm$ 1.1 ^a	6.08 $\pm$ 0.9 ^{ab}	6.18 $\pm$ 1.9 ^{bc}	6.15 $\pm$ 2.3 ^{ab}
	T5	6.27 $\pm$ 0.4	6.40 $\pm$ 0.1 ^a	6.27 $\pm$ 1.3 ^a	6.12 $\pm$ 0.2 ^{bc}	6.26 $\pm$ 0.4 ^a
	T6	6.18 $\pm$ 1.6	6.23 $\pm$ 0.4 ^{ab}	6.17 $\pm$ 0.7 ^{ab}	6.43 $\pm$ 0.6 ^{ab}	6.25 $\pm$ 0.5 ^a
	T7	6.43 $\pm$ 1.0	6.30 $\pm$ 0.9 ^{ab}	6.28 $\pm$ 0.6 ^a	6.25 $\pm$ 2.3 ^{bc}	6.32 $\pm$ 0.4 ^a
	T8	6.00 $\pm$ 1.3	6.28 $\pm$ 0.3 ^{ab}	6.08 $\pm$ 0.7 ^{ab}	6.22 $\pm$ 0.7 ^{bc}	6.15 $\pm$ 0.6 ^{ab}
	T9	5.95 $\pm$ 2.0	6.40 $\pm$ 1.3 ^a	6.33 $\pm$ 0.9 ^a	6.22 $\pm$ 0.4 ^{bc}	6.23 $\pm$ 0.7 ^a
Significant		N.S	**	**	**	**

T1: Control treatment: basal diet (residue-free). T2, T3, T4, T5: Use of local shiitake mushroom waste powder at 2, 4, 6 and 8%, respectively, in the basal diet. T6, T7, T8, T9: Use of local shiitake mushroom waste powder at 2, 4, 6 and 8%, respectively, with the addition 0.05% of probiotics to the basal diet. **Statistically significant differences at $P \leq 0.01$. N.S.: Not statistically significant

Table (8) shows the effect of using different proportions of local shiitake mushroom waste powder with or without adding probiotics in the feed of laying hens on the weekly egg mass. The results showed highly significant differences ($P \leq 0.01$) between the different treatments in the first period (22-25) weeks, as treatments T7, T2 significantly outperformed the control treatment T1 at a rate of 408.08, 410.77 g, respectively, while treatments T9, T8, T6, T5, T4, T3 did not differ significantly between them and did not differ from the rest

of the experimental treatments in the same period. In the second period (26-29) weeks, the results indicated the presence of highly significant differences ($P \leq 0.01$) between the different treatments of the experiment, as treatment T9 significantly outperformed treatment T6, T1 at a rate of 412.33 g, while treatment T1, the control treatment, significantly decreased over the rest of the experimental treatments at a lower rate of 345.48 g in the same period, while treatments T8, T7, T5, T4, T3, T2 did not differ

significantly among themselves and did not differ from treatments T9, T6 in the same period. In the third period (30-33) weeks, the results showed highly significant differences ($P \leq 0.01$) between the different treatments of the experiment, as treatments T9, T3, T2 significantly outperformed treatments T8, T6, T4, T1 at a rate of 397.25, 395.58, 393.50 g, respectively, while treatments T8, T4 did not differ significantly among themselves and did not differ from the rest of the treatments T7, T6, T5, T1 in the same period as well, while treatments T7, T5 did not differ significantly among themselves and did not differ from treatments T9, T8, T6, T4, T3, T2 in the same period. In the fourth period (34-37) weeks, the results indicated the presence of highly significant differences ($P \leq 0.01$) between the different treatments, as treatment T2 significantly outperformed treatments T8, T5, T4, T1 with an average of 423.83 g, while treatments T9, T7, T6, T3 did not differ significantly between them and did not differ

from the rest of the different experimental treatments in the same period. As for the total period (22-37) weeks, the results showed the presence of highly significant differences ($P \leq 0.01$) between the different treatments of the experiment, as treatments T3, T2 significantly outperformed treatments T8, T6, T4, T1 with an average of 400.58, 408.11 g, respectively, while treatments T9, T7, T5 did not differ significantly between them and did not differ from treatments T8, T6, T4, T3, T2 in the same period for the weekly egg mass trait. Table (9) shows the effect of using different proportions of local shiitake mushroom waste powder with or without adding probiotics in the diet of laying hens on weekly feed consumption. The results indicated that there were no significant differences between the different treatments of the experiment in the first period (22-25) weeks. As for the second period (26-29) weeks, the results showed highly significant

Table 8. The effect of using local shiitake mushroom waste powder with or without adding probiotics in the feed of laying hens on the weekly egg (mean $\pm$ stander error)

Egg Mass Weekly	Period (Weeks) gm egg/bird/weekly				
	First period 22-25	Second period 26-29	Third period 30-33	Fourth period 34-37	Total period 22-37
T1	352.65 $\pm$ 13.58 ^b	345.48 $\pm$ 12.99 ^c	351.65 $\pm$ 19.58 ^c	381.33 $\pm$ 11.30 ^b	357.78 $\pm$ 12.46 ^c
T2	410.77 $\pm$ 5.2 ^a	404.33 $\pm$ 4.37 ^{ab}	393.50 $\pm$ 6.74 ^a	423.83 $\pm$ 5.73 ^a	408.11 $\pm$ 6.4 ^a
T3	403.58 $\pm$ 7.00 ^{ab}	405.42 $\pm$ 7.16 ^{ab}	395.58 $\pm$ 1.31 ^a	397.75 $\pm$ 9.50 ^{ab}	400.58 $\pm$ 4.79 ^a
T4	376.42 $\pm$ 38.03 ^{ab}	409.25 $\pm$ 3.33 ^{ab}	378.00 $\pm$ 2.38 ^{bc}	384.63 $\pm$ 9.62 ^b	387.08 $\pm$ 12.00 ^b
T5	398.17 $\pm$ 2.68 ^{ab}	397.83 $\pm$ 1.69 ^{ab}	383.08 $\pm$ 8.2 ^{ab}	384.25 $\pm$ 5.45 ^b	390.83 $\pm$ 1.88 ^{ab}
T6	392.80 $\pm$ 12.48 ^{ab}	383.67 $\pm$ 11.98 ^{bc}	381.83 $\pm$ 2.25 ^b	391.33 $\pm$ 17.50 ^{ab}	387.41 $\pm$ 5.21 ^b
T7	408.08 $\pm$ 4.59 ^a	394.95 $\pm$ 7.43 ^{ab}	382.08 $\pm$ 12.46 ^{ab}	400.08 $\pm$ 14.18 ^{ab}	396.30 $\pm$ 4.55 ^{ab}
T8	381.42 $\pm$ 11.71 ^{ab}	403.25 $\pm$ 2.67 ^{ab}	376.33 $\pm$ 6.59 ^{bc}	388.83 $\pm$ 7.88 ^b	387.46 $\pm$ 6.21 ^b
T9	382.20 $\pm$ 14.05 ^{ab}	412.33 $\pm$ 8.62 ^a	397.25 $\pm$ 10.31 ^a	396.25 $\pm$ 2.75 ^{ab}	397.01 $\pm$ 5.51 ^{ab}
Significant	**	**	**	**	**

T1: Control treatment: basal diet (residue-free). T2, T3, T4, T5: Use of local shiitake mushroom waste powder at 2, 4, 6 and 8%, respectively, in the basal diet. T6, T7, T8, T9: Use of local shiitake mushroom waste powder at 2, 4, 6 and 8%, respectively, with the addition 0.05% of probiotics to the basal diet. **Statistically significant differences at $P \leq 0.01$. N.S.: Not statistically significant

differences ($P \leq 0.01$) between the different treatments. Treatments T9, T8, T7, and T4 significantly outperformed the control treatment T1 at a rate of 675.82, 676.00, 672.08, and 671.42 g, respectively, while treatments T6, T5, T3, and T2 did not differ significantly between themselves or from the rest of the treatments in the same period. In the third period (30-33) weeks, treatments T8, T7, T2 significantly outperformed the control treatment T1 at a rate of 659.83, 660.67, 662.67 g, respectively, while the addition

treatments T9, T6, T5, T4, T3 did not differ significantly among themselves and did not differ from the rest of the experimental treatments in the same period. As for the fourth periods (34-37) weeks and the total (22-37) weeks, the results showed that there were no significant differences between the different treatments of the experiment for these periods in terms of weekly feed consumption. Table (10) shows the effect of using different proportions of local shiitake mushroom waste powder with and without adding probiotics in

the feed of laying hens on the feed conversion ratio. The results indicated that there were no significant differences between the different treatments in the first period (22-25) weeks and the third period (30-33) weeks. As for the second period (26-29) weeks, the results indicated that there were highly significant differences ($P \leq 0.01$) between the different treatments. Treatments T9, T4, T3, T2 significantly outperformed treatments T6, T1 with the best feed conversion ratio of 1.64, 1.65, 1.65, 1.66 g, respectively, while treatments T8, T7, T5 did not differ significantly between them and did not differ from treatments T9, T6, T4, T3, T2 in the same period. The results also showed that there were highly significant differences ($P \leq 0.01$) between the different treatments in the fourth period (34-37) weeks, as treatment

T2 significantly outperformed treatments T5, T4 with the best feed conversion ratio at a rate of 1.57 kg, while treatments T9, T8, T7, T6, T3, T1 did not differ significantly between them and did not differ from the rest of the experimental treatments in the same period. As for the total period (22-37) weeks, the results indicated that there were highly significant differences ($P \leq 0.01$) between the different treatments of the experiment, as treatments T7, T3, T2 significantly outperformed the control treatment T1 with the best feed conversion ratio at a rate of 1.69, 1.66, 1.64 g, respectively, while treatments T9, T8, T6, T5, T4 did not differ significantly between them and did not differ from the rest of the experimental treatments in the same period in terms of feed conversion ratio.

Table 9. shows the effect of using local shiitake mushroom waste powder with or without adding probiotics in the feed of laying hens on weekly feed consumption (mean $\pm$ stand error)

Feed consumption Weekly		Period (Weeks) gm feed/bird/weekly				
		First period 22-25	Second period 26-29	Third period 30-33	Fourth period 34-37	Total period 22-37
treatment	T1	633.42 $\pm$ 34.84	650.92 $\pm$ 10.88 ^B	618.75 $\pm$ 35.56 ^B	638.17 $\pm$ 34.96	635.31 $\pm$ 29.03
	T2	673.33 $\pm$ 6.5	667.42 $\pm$ 1.80 ^{AB}	662.67 $\pm$ 3.53 ^A	664.25 $\pm$ 5.2	666.92 $\pm$.65
	T3	658.20 $\pm$ 6.78	667.67 $\pm$ 5.8 ^{AB}	656.50 $\pm$ 4.48 ^{AB}	670.25 $\pm$ 1.66	663.15 $\pm$ 2.48
	T4	658.75 $\pm$ 13.88	671.42 $\pm$ 2.57 ^A	656.67 $\pm$ 2.83 ^{AB}	664.92 $\pm$ 2.44	662.94 $\pm$ 3.06
	T5	663.83 $\pm$ 2.97	667.50 $\pm$ 1.26 ^{AB}	656.08 $\pm$ 4.37 ^{AB}	665.08 $\pm$ 5.8	663.13 $\pm$ 7.7
	T6	661.08 $\pm$ 3.39	669.25 $\pm$ 1.98 ^{AB}	655.50 $\pm$ 3.00 ^{AB}	665.83 $\pm$ 1.73	662.92 $\pm$ 1.38
	T7	664.08 $\pm$ 3.89	672.08 $\pm$ 2.62 ^A	660.67 $\pm$ 1.66 ^A	665.83 $\pm$ 1.34	665.67 $\pm$ 2.05
	T8	666.77 $\pm$ 1.02	676.00 $\pm$ 4.11 ^A	659.83 $\pm$ 5.8 ^A	664.42 $\pm$ 2.76	666.75 $\pm$ 3.6
	T9	663.92 $\pm$ 5.84	675.82 $\pm$ 3.25 ^A	659.17 $\pm$ 2.29 ^{AB}	666.00 $\pm$ 1.70	666.23 $\pm$ 1.66
Significant		N.S	**	**	N.S	N.S

T1: Control treatment: basal diet (residue-free). T2, T3, T4, T5: Use of local shiitake mushroom waste powder at 2, 4, 6 and 8%, respectively, in the basal diet. T6, T7, T8, T9: Use of local shiitake mushroom waste powder at 2, 4, 6 and 8%, respectively, with the addition 0.05% of probiotics to the basal diet. **Statistically significant differences at $P \leq 0.01$. N.S.: Not statistically significant.

Table 10. Effect of using local shiitake mushroom waste powder with or without adding probiotics in laying hens' feed on the feed conversion ratio (mean $\pm$ stander error)

Feed conversion ratio		Period (Weeks) gm feed/gm egg mass				
		First period 22-25	Second period 26-29	Third period 30-33	Fourth period 34-37	Total period 22-37
treatment	T1	1.81 $\pm$ 0.3	1.89 $\pm$ 0.5 ^a	1.77 $\pm$ 0.6	1.67 $\pm$ 0.4 ^{ab}	1.79 $\pm$ 0.2 ^a
	T2	1.64 $\pm$ 0.1	1.66 $\pm$ 0.2 ^c	1.69 $\pm$ 0.2	1.57 $\pm$ 0.2 ^b	1.64 $\pm$ 0.0 ^b
	T3	1.64 $\pm$ 0.4	1.65 $\pm$ 0.3 ^c	1.66 $\pm$ 0.1	1.69 $\pm$ 0.4 ^{ab}	1.66 $\pm$ 0.2 ^b
	T4	1.78 $\pm$ 1.6	1.65 $\pm$ 0.2 ^c	1.74 $\pm$ 0.2	1.74 $\pm$ 0.5 ^a	1.73 $\pm$ 0.5 ^{ab}
	T5	1.67 $\pm$ 0.1	1.68 $\pm$ 0.1 ^{bc}	1.72 $\pm$ 0.1	1.74 $\pm$ 0.2 ^a	1.70 $\pm$ 0.1 ^{ab}
	T6	1.70 $\pm$ 0.6	1.80 $\pm$ 1.0 ^{ab}	1.72 $\pm$ 0.1	1.71 $\pm$ 0.8 ^{ab}	1.73 $\pm$ 0.4 ^{ab}
	T7	1.63 $\pm$ 0.2	1.70 $\pm$ 0.2 ^{bc}	1.74 $\pm$ 0.6	1.67 $\pm$ 0.6 ^{ab}	1.69 $\pm$ 0.2 ^b
	T8	1.76 $\pm$ 0.6	1.68 $\pm$ 0.0 ^{bc}	1.76 $\pm$ 0.3	1.71 $\pm$ 0.4 ^{ab}	1.73 $\pm$ 0.3 ^{ab}
	T9	1.79 $\pm$ 1.1	1.64 $\pm$ 0.3 ^c	1.66 $\pm$ 0.5	1.68 $\pm$ 0.2 ^{ab}	1.70 $\pm$ 0.3 ^{ab}
Significant		N.S	**	N.S	**	**

T1: Control treatment: basal diet (residue-free). T2, T3, T4, T5: Use of local shiitake mushroom waste powder at 2, 4, 6 and 8%, respectively, in the basal diet. T6, T7, T8, T9: Use of local shiitake mushroom waste powder at 2, 4, 6 and 8%, respectively, with the addition 0.05% of probiotics to the basal diet. **Statistically significant differences at $P \leq 0.01$. N.S.: Not statistically significant

Through the results of this study, a clear, significant improvement was observed in most production traits, including egg production rate, cumulative egg number, egg mass, feed consumption, and feed conversion ratios for treatments that used local shiitake mushroom waste in their feed, consisting of a mixture of wheat bran and corn cobs, with and without the addition of probiotics. The results were similar and parallel to those of the control treatment, which used corn and wheat. This may be due to the role of mushroom growth on the waste mixture and its fermentation using shiitake mushrooms, which worked to transform these low-nutrition wastes, which contain a high percentage of fibers such as cellulose and cellulose-like substances (Abaza et al,2004), into products with high nutritional value. This was achieved by reducing the percentage of indigestible fibers and increasing the percentage of protein, fat, and easily digestible carbohydrates (Aguilar-Rivera and Olvera- Vargas, 2023). This is what this study demonstrated after analyzing these wastes before and after fermentation by growing mushrooms on them, as shown in the table (1) which has a positive impact on improving the productive performance of laying hens. The reason may also be due to the shiitake mushroom waste powder containing a large group of active substances and biologically active compounds, including flavonoids, phenols, and carotenoids (Alemu,2014). This is also what this study showed in Table (2), as these substances work as effective antioxidants that improve the physiological condition of laying hens, which is reflected in activating metabolic processes within the body of birds and thus a positive improvement in productive performance (Al-Azzawi and Bander,2023). The reason for the improvement in productive performance of feeds using shiitake mushroom waste with the addition of probiotics may be due to the increased fermentation of these wastes and the bio-enhancer, which in turn works to improve the digestive environment in the intestine and increase the benefit from digestion and absorption of important nutrients by reducing the number of harmful bacteria and increasing the number of beneficial bacteria in the

intestine, which in turn improves the health condition of birds (Yasmeen and Ahmad, 2025). The development of local shiitake mushrooms on a mixture of corn cobs and wheat bran, i.e. agricultural waste for mushrooms, has worked to increase The types and concentrations of essential amino acids in these wastes, as shown in Table 4, enhance the biological value of the protein in these wastes and the extent to which laying hens benefit from this protein in increasing and improving productive performance (Ndego et al., 2023).

CONCLUSION

So this study can be concluded that growing local shiitake mushrooms on a mixture of low-nutritional value corn cobs and wheat bran and fermenting them has improved their nutritional value and significantly reduced environmental pollution resulting from these agricultural wastes. It also provides the potential for their use as a partial substitute for corn in laying hens' feed, with and without the addition of probiotics, and has a positive impact on improving productive performance.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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تأثير استعمال مسحوق مخلفات تنمية الفطر الشيتاكي المحلي *Lentinus edodes* في الاداء الإنتاجي للدجاج البياض البني

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المستخلص

أجريت هذه الدراسة في محطة أبحاث الدواجن في أبي غريب التابعة لدائرة البحوث الزراعية / وزارة الزراعة للمدة من 2024/6/27 إلى 2024/10/17 لمعرفة تأثير استعمال مستويات مختلفة من مسحوق مخلفات الفطر الشيتاكي المحلي في عليقة الدجاج البياض مع او بدون إضافة البروبايتك وتأثيره في الاداء الإنتاجي للدجاج اذ استعمل في التجربة 135 دجاجة بياض نوع ISA Brown بعمر 20 أسبوع. موزعة على 9 معاملات كل معاملة تحتوي على 3 مكررات وكل مكرر يحتوي على 5 دجاجة. وكانت المعاملات كالاتي: معاملة السيطرة T1: العليقة الأساس بدون استعمال مخلفات الفطر الشيتاكي اما المعاملات T5, T4, T3, T2 فقد تم استعمال مخلفات الفطر الشيتاكي فيها بنسبة 8, 6, 4, 2 % على التوالي اما المعاملات T9, T8, T7, T6 فقد تم استعمال مخلفات الفطر الشيتاكي فيها بنفس النسب على التوالي مع إضافة 0.05 % من المعزز الحيوي. اذ بينت النتائج في نسبة انتاج البيض (H.D%) تفوقت المعاملات T7, T2 معنويا على المعاملات T9, T8, T4, T1. عدد البيض التراكمي فقد اشارت النتائج الى تفوق المعاملات T3, T2, T5, T6, T7, T9 معنويا على معاملة السيطرة T1 في المدة الكلية (22-37) أسبوعا. اما في صفة كتلة البيض الأسبوعي اذ بينت النتائج حصول تفوق معنوي $P \leq 0.01$ للمعاملات T3, T2 على المعاملات T8, T6, T4, T1. معامل التحويل الغذائي تحسنت معنويا $P \leq 0.01$ للمعاملات T7, T3, T2 على معاملة السيطرة T1 في المدة الكلية.

الكلمات المفتاحية: العدد التراكمي للبيض، كتلة البيض، سلالة (ISA Brown) "، المعزز الحيوي.