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The effect of the synergistic mixture of oyster mushroom *Pleurotus ostreatus* and beta-glucan added to the diet on the productive performance of broilers under heat stress

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Abstract

Current study showed the effect of adding the synergistic mixture of oyster mushrooms and beta-glucans on the productive performance of broilers under heat stress. 300 one-day-old chicks (Ross 308) were used and randomly distributed to four-treatments. Control treatment was fed standard diet. While the second, third and fourth treatments were fed starter ration with addition synergistic mixture at level (0.5, 1, and 1.5) g / kg. while 0.250, 0.5, 0.750) g/kg of oyster mushroom and beta-glucans for the same treatments, respectively were added to final diet. Results showed a significant effect ($P<0.05$) in body weight, rate of weight gain, decrease in the amount of feed consumed, improve in feed conversion efficiency and decrease in mortality rate, compared to control treatment. Current study conclude that addition of the synergistic mixture at level of 1.5 g / kg to the feed improved the productive and economic performance of broiler chickens.

Keywords: Beta-glucans; Oyster mushroom; Performance index; Productivity performance; Synbiotic Mixture

1. Introduction

More than 90 billion tons of poultry meat are produced annually [1]. This high production of poultry meat requires developing poultry industry in order to face the rise in market demand of meat and eggs [2]. Poultry meat is one of the most important sources of animal protein, which is distinguished from other protein sources, which has high nutritional value [3]. The main problems facing animal production in countries with tropical and subtropical climates is heat stress, which negatively affects the performance of poultry [4]. Researchers were interested in using some strategies to find out their effect on some immune traits of broiler chickens, including vegetable additives [5]. Studies were conducted on the genetic side of chickens exposed to heat stress in order to predict the ability of birds to withstand stress conditions [6]

[7], [8], showed that heat stress leads to changes in the bacterial content of the intestine. The use of probiotics has many beneficial properties in raising immunity and improving the intestinal structure.These factors improve digestion and absorption, which is ultimately reflected in improved performance outcomes during H.S [9].

[10]. Found that the prebiotic has an important role in closing the receptors on the surface of the walls of pathological bacteria. The prebiotic is a source of nourishment for beneficial intestinal bacteria. Oyster mushrooms, which contain many valuable benefits, are rich in dietary fiber, protein, vitamins and minerals, with low values of fat and calories [11] [12] show that oyster mushrooms added to feed led to a significant improvement in the productive and immune traits

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of poultry. The study aimed to find out the effect of using a synbiotic mixture consisting of oyster mushrooms *Pleurotus ostreatus* and beta-glucan on the productive performance of exposed broilers to heat stress.

2. Material and methods

This study was conducted in the poultry research field at the Agriculture College - University of Basrah from 17/1/2022 to 22/2/2022. In this research, 300 unsexed broiler chicks (Ross308) were used in this study, at the age of one day, with average starting weight 42 g. Birds were distributed randomly into four treatments, and each treatment was divided into three replications (25 birds / replicate).Chicks were reared on the floor and sawdust was used as a mattress to cover the floor. The hall was divided in the form of iron nests , and the dimensions of one repetition were (100 x 200 x 75) cm. birds were fed free feed on starting diet from (1-21) days and growing diet from (22-35) days, as shown in Table (1).

First treatment was fed on standard diet. The synergistic mixture was added to the second treatment at level 0.5 g/kg for starter and as 0.250 g/kg for the final feed. Third treatment was fed 1 g/kg for the starter and 0.5 g/kg for the final. The synergistic mixture was added to the fourth treatment at the rate of 1.5 g / 1 kg of feed for the starter and 0.750 g / 1 kg of feed for the final. The birds exposed to heat stress from one-day age, by exposing all the birds to heat stress for 8 hours / day by raising the room temperature (Table 2).

2.1. Prepare the synergistic mixture

- The mycelium of the oyster mushroom *Pluerotes ostreatus* was obtained from the National Center for Organic Agriculture / Plant Protection Department / Ministry of Agriculture.
- The beta-glucan was prepared from one of the offices for medical and laboratory supplies ،in a package of (500)g.
- Oyster fungus was added with the same amount of beta-glucan to the diet. It was mixed well and incubated in polyethylene bags at (28-30) 0 and humidity (40-50) % for period (7-10) days until the growth of the mycelium distinguished by its strong smell, then it is mixed with the quantity required to feed the birds. [13].

2.2. Studied traits

2.2.1. Productivity traits

Live body weight (B.W), weight gain (BWG), and feed intake were calculated (FI), feed conversion efficiency (FCR) in addition to the amount of water consumed according to the equations approved and mentioned by [12]

2.3. Economic characteristics

The Productivity Index (PI) and the Economic Efficiency Index (EEI) the production index and the economic indicator scale were calculated for each transaction according to the formula that was approved by [14].

$$\text{Production index (PI)} = \frac{Average\ of\ live\ weight\ in\ (gm) \times liveability\ percentag}{Age\ in\ days\ \times FCR\ \times\ 10}$$

$$\text{Economic efficiency index (EEI)} = \frac{\text{Average of live weight in (kg)} \times \text{liveability percentage} \times 100}{\text{Age in days} \times \text{FCR}}$$

2.4. Performance Evidence Scale

Calculate the performance evidence for each transaction according to the equation mentioned [15].

$$\text{Performance index} = \frac{\text{average live body weight (gm)}}{\text{Average feed conversion efficiency} \times 10}$$

2.4.1. Scale of the economic evidence of the diet

The economic efficiency of each treatment was calculated according to the following equation.

Economic efficiency = feed cost (amount of feed intake kg^{-1} of live weight) x feed conversion efficiency.

2.4.2. Percentage of Mortality

Mortality in each replicate was recorded daily, calculated as a percentage of the total number of chicks in each replicate, and treated at the end of the experiment according to the following equation:

$$\text{Percentage of Mortality} = \frac{\text{The number of total mortality}}{\text{total number of birds}} \times 100$$

2.5. Statistical Analysis

Complete random design (CRD) was used, using (SPSS, 2019) program in the statistical analysis and using the following mathematical model (yij = μ + ti + eij).

Table 1 The approved periodic temperatures during the experiment period

Age/day	**1-7**	**8-21**	**22-35**
Temperature	038-40	0 34-36	0 27 – 29

Note that the period of exposing birds to heat is (8) hours per day, then it is gradually reduced

Table 2 The components of the diet used in the experiment

Items	**Starter diet (1-21)days(%)**	**Grower diet (22-35)days(%)**
Yellow corn	56	58
Wheat	4.5	8
Soybean meal(%48)	32	27
The concentrated Protein*	5	4
Limestone	0.7	0.7
Plant Oil	0.5	1
Mixture of vitamins and minerals**	1	1
Salt	0.3	0.3
Total	%100	%100
Calculated chemical composition* **		
Crude Protein(%)	22.98	20.82
Kilo calories energy/kg feed	2970	3048

* Protein concentrate for feeding broiler chickens (Brocorn-5 special W) produced by (Wafi B.V. Alblasserdam-Holland), chemical composition: 40% crude protein, 5% crude fat, 2.20% crude fiber, 7.10% moisture, 28.30% crude ash , 4.20% calcium, 2.65% phosphorus, 2107, energy (kcal kg-1). 3.70% methionine, methionine + cysteine 0.42%, lysine 4.12%, tryptophan 0.42%, threonine 1.70%, sodium 2.50%, chlorine 4.20%, copper 200 mg kg-1, manganese 1,600 mg kg-1, zinc 2,000 mg kg-1, iodine 20.00 mg/kg, iron 2.000 mg kg-1, selenium 5.00 mg kg-1 ** a mixture of minerals and vitamins, chemical composition: 10% crude protein, 2.1% crude fat, 0.34% crude fiber, 2.66% moisture, 51.02% crude ash, 20.08% Calcium, 10.83% Phosphorus, 753.82 kcal kg-1. energy (kcal.g1). *** Calculation of the chemical composition of the feed was made according to NRC (1994).

3. Results and discussion

3.1. Productive performance

3.1.1. Body weight and weight gain

Table (3) showed the effect of adding the synergistic mixture of oyster mushroom and beta-glucan on Body weight, where no significant differences were observed in the rates of body weight of birds in the first week .In the second week, fourth treatment was superior significantly (P<0.05) which was 286.54 (g) while second treatment and control treatment recorded 275.76 and 264.80 (g) respectively. As for the third, fourth and fifth week, fourth treatment increase significantly (P<0.05) in the average body weight compared to the others treatments, it reached (1535.15) g at the end of the experiment at the age 35 days. Table (4) showed the effect of adding the synergistic mixture of oyster mushroom and beta-glucan in weight gain which took same body weight curve, where no significant differences observed in the rates of weight gain of birds at the first week , while there is significant increase (P < 0.05) in the second, third, fourth and fifth weeks when calculating the cumulative gain. The table showed that fourth treatment recorded 140.51 (g) did not differ significantly in the second week from the third and second treatment which recorded (140.20, 134.67) g respectively.

Table 3 The effect of adding the synergistic mixture of *Pleurotus ostreatus* and beta-glucan to the ration of broiler chickens exposed to heat stress at different age stages on body weight (g) (mean ± standard error)

Temperature	Age in Days				
	(1-7) days	(8-14) days	(21-15)days	(22-28) days	(29-35) days
T1	142.21± 2.89	264.80c ±2.96	555.18c± 1.71	1020.67d ±2.33	1535.15d ±3.77
T2	141.13±2.01	275.76b±3.28	574.18b ±2.09	1034.76c± 3.52	±1566.06c ±2.69
T3	142.22±2.65	282.42ba±2.56	579.72b ±4.11	1084.63b±2.96	1633.37b ± 3.81
T4	143.36±3.50	286.54a ± 2.68	597.17 a ±2.53	1140.37a±2.57	1710.96a ±3.46
Sig.	N.S	*	*	*	*

(*) The different letters in each column indicate a significant difference (p<0.05). N.S. (**) means that there are no significant differences between the averages (***)Transactions (T1) were the control treatment without addition, while the second treatment (T2) was The addition of the tarzi mixture of oyster mushroom and beta-glucan was 0.5 g / 1kg feed for the starter and 0.250 g / 1kg feed for the final for both oyster mushroom and beta-glucan, while the third treatment (T3) the amount was 1 g / 1kg feed for the starter and 0.5 g / 1kg of final feed for both oyster mushroom and beta-glucan, and the fourth treatment (T4) was added to the mixture at the rate of 1.5 g / 1kg feed for starter and 0.750 g / 1kg feed for final for both oyster mushroom and beta-glucan.

Table 4 The effect of adding the synergistic mixture of *Pleurotus ostreatus* and beta-glucan to the diet of broiler chickens exposed to heat stress at different age stages on the rate of weight gain (gm) (mean ± standard error**)**

Tempera-ture	Age in Days					Cumulative
	(1-7) days	(8-14) days	(21-15)days	(22-28) days	(29-35) days	
T1	±100.21±2.89	122.59^{b}±4.67	290.38^{c}±3.83	465.48^{c} ±0.69	514.48^{d}±5.30	1493.15^{d} ±3.77
T2	±99.13±2.01	134.67^{a}±5.28	298.42^{ab}±3.78	460.58^{c}±2.73	531.29^{c}±3.53	1524.06^{c}±2.69
T3	±100.22±2.65	140.20^{a}±4.07	297.29^{ab}±2.57	504.91^{b}±2.48	548.77^{b}±5.65	1591.37^{b}±3.81
T4	±101.3±63.50	140.51^{a}±3.89	307.96^{a}±2.40	543.20^{a}±0.70	570.59^{a}±0.92	1663.62^{a}±8.36
Sig.	N.S	*	*	*	*	*

(*) The different letters in each column indicate a significant difference (p<0.05). N.S. (**) means that there are no significant differences between the averages (***)Transactions (T1) were the control treatment without addition, while the second treatment (T2) was The addition of the tarzi mixture of oyster mushroom and beta-glucan was 0.5 g / 1kg feed for the starter and 0.250 g / 1kg feed for the final for both oyster mushroom and beta-glucan, while the third treatment (T3) the amount was 1 g / 1kg feed for the starter and 0.5 g / 1kg of final feed for both oyster mushroom and beta-glucan, and the fourth treatment (T4) was added to the mixture at the rate of 1.5 g / 1kg feed for starter and 0.750 g / 1kg feed for final for both oyster mushroom and beta-glucan

While it differed significantly with control treatment (T1), which recorded increase of (122.59) g, results at the age of (35) days indicated that the cumulative weight gain (1591.37, 1524.06, 1493.15) g for the third ,second and control treatments, respectively, fourth treatment achieved significant increase in weight of 1663.62 (g). The presence of these significant differences between the fourth treatment with others treatments may be due to the superiority of the treatments to which the synergistic mixture was added, this is because it contains many proteins, vitamins and minerals, in addition to its content polysaccharides and biologically active compounds that positively affect growth performance [16]. Its proteins are also characterized by being high quality and containing important amino acids such as lysine and leucine [17]. Fungi also have beneficial effects on the digestive system by increasing the production of digestive enzymes, which work to enhance liver function, which contribute to increasing the utilization of feed by improving digestion [18] [19]. Thus, the results obtained converged with what was found by [12], which showed that feeding oyster mushrooms to chickens led to improvement in weight gain and feed conversion ratio.

3.2. Amount of feed consumed and feed conversion efficiency

Table (5) showed the effect of adding the synergistic mixture of oyster mushroom and beta-glucan on the amount of feed consumed during the first week of the experiment as no significant differences appeared between all treatments. There was a significant difference between the treatments at the second, third, fourth and fifth weeks, in addition to, the cumulative feed quantity, the amount of feed consumed decreased as a result of exposure birds to heat stress in all treatments except for the fourth treatment which was superior significantly ($P<0.05$) it was recorded 2772.59 g compared to the third, second and control treatment , which were (2678.12, 2620.10, 2580.75) g, respectively results in table (6) showed the effect of adding the synergistic mixture of oyster mushroom and beta-glucan on the efficiency of food conversion. No significant differences appeared between all treatments during the first, second and third week of the experiment, while there was a significant improvement ($P<0.05$) in the values of the feed conversion coefficient in the fourth week, \ third treatment recorded the lowest rate 1.62 g feed / g gain in weight, while second treatment recorded the highest rate 1.74 g feed / g gain, fourth treatment recorded the lowest value it reached 1.80 g feed / g gain compared with the control treatment which recorded the highest rate 1.91 g feed / g gain in weight in the fifth week and the fourth treatment recorded the lowest cumulative conversion factor at rate 1.59 g feed / g gain compared with control treatment which was 1.66 g feed / g gain weight. Improvement in the amount of feed consumed and feed conversion factor for the treatments may be due to the synergistic mixture that added compared to the control treatment.Heat stress effect on the behavioral and physiological functions of birds, through which birds try to regulate their body temperature, including reducing the amount of feed consumed [20]. The decrease in the amount of feed consumed leads to a decrease in the average body weight and feed conversion efficiency, which was reflected in the performance rate [21], [22]. The improvement for feed consumed and the efficiency of feed conversion for the treatments added to the synergistic mixture, especially the fourth treatment may be due to the characteristics and biologically active compounds in mushrooms that have beneficial effects on growth performance and immune responses [16]. It has been proven that mixing mushrooms with beta-glucan improves digestion in the intestine and raises immunity and growth in poultry [23], [24], showed that oyster mushroom protein extract improved growth and feed conversion rates (FCR).

Table 5 The effect of adding the synergistic mixture of *Pleurotus ostreatus* and beta-glucan to the broilers exposed to heat stress at different age stages on the amount of feed consumed (g) (mean ± standard error).

Temperature	**Age in Days**					**Cumulative**
	(1-7) days	**(8-14) days**	**(21-15)days**	**(22-28) days**	**(29-35) days**	
T1	140.03±2.93	196.05b±3.76	480.79b±5.24	794.65c±3.44	969.22c±5.16	2580.75c± 12.93
T2	138.67±4.66	206.14ab±3.37	488.40ab±6.15	798.55c±4.38	988.35b±5.50	2620.10c± 13.15
T3	140.10±3.42	209.68a±4.32	494.81ab±4.46	815.68b±2.80	1017.85±2.95	2678.12b± 11.08
T4	138.56±3.36	213.13a±3.69	505.83a±5.25	885.85a±6.41	1029.23a±6.41	2772.59a± 15.67
Sig.	N.S	*	*	*	*	*

(*) Different letters in each column indicate a significant difference ($p<0.05$). N. S. means that there are no significant differences between the means. ** Treatment .the (T1) control treatment was without any addition.the(T2)second treatment The added amount of the synergistic mixture was 0.5 g / kg for the starter and 0.250 g / kg feed for the final of feed for each oyster mushroom and beta-glucans , the (T3)third treatment was 1 gm/kg for the starter and 0.5 g / kg feed for the final of feed for each oyster mushroom and beta-glucans, and for the (4) fourth treatment, the mixture was added by 1.5 gm/kg for the starter and 0.750 g / kg feed for the final of oysters and beta-glucan feeds.

Table 6 The effect of adding the synergistic mixture of *Pleurotus ostreatus* and beta-glucan to the diet of broiler chickens subjected to heat stress at different age stages on feed conversion efficiency (mean ± standard error).

Temperature	Age in Days					Total
	(1-7) days	(8-14) days	(21-15)days	(22-28) days	(29-35) days	
T1	1.40±0.07	1.61±0.08	1.65±0.03	1.71ᵇ±0.09	1.91ᵃ±0.03	1.66ᵃ±0.01
T2	1.40± 0.06	1.54±0.04	1.64±0.03	1.74 ᵃ± 0.03	1.86ᵃᵇ±0.02	1.63 ᵃᵇ± 0.1
T3	1.40± 0.07	1.50±0.03	1.66±0.01	1.62ᶜ±0.06	1.86ᵃᵇ±0.02	1.61 ᵃ ±0.09
T4	1.37± 0.05	1.52±0.01	1.64±0.02	1.63ᶜ±0.01	1.80 ᵇ± 0.09	1.59ᵇ± 0.2
Sig.	**N.S**	**N.S**	**N.S**	*	*	*

(*) Different letters in each column indicate a significant difference (p<0.05). N. S. means that there are no significant differences between the means. ** Treatment .the (T1) control treatment was without any addition.the(T2)second treatment The added amount of the synergistic mixture was 0.5 g / kg for the starter and 0.250 g / kg feed for the final of feed for each oyster mushroom and beta-glucans , the (T3)third treatment was 1 gm/kg for the starter and 0.5 g / kg feed for the final of feed for each oyster mushroom and beta-glucans, and for the (4) fourth treatment, the mixture was added by 1.5 gm/kg for the starter and 0.750 g / kg feed for the final of oysters and beta-glucan feeds.

3.3. Economic criteria and death rate

Table (7) shows the effect of adding the synergistic mixture of oyster mushroom and beta-glucan on some economic parameters of birds exposed to heat stress, which included economic index, production index, performance index, and number of deaths. The results showed that there were significant differences in the percentage of deaths, as the fourth treatment did not record deaths throughout the experiment period while control treatment and second treatment recorded deaths during the experimental period of 35 days. The economic index for fourth treatment recorded the highest significant difference (P<0.05), as it reached 711.12, compared with third, second and control treatment, which recorded 663.48, 635.04, and 623.13, respectively. As for the productive index, fourth treatment recorded 306.91 compared to the control treatment, which recorded 254.35 .

Table 7 The effect of adding the synergistic mixture of the oyster mushroom *plurotus ostreatus* and beta-glucan to the diet of broilers subjected to heat stress at different age stages on the economic index, the productive index, the percentage of mortality, the economic index, and the performance index at the age of 35 days (mean ± standard error)

Temperature	Economic index	Production index	Mortality %	Economic efficiency index	Performance index
T1	623.13 c ±6.41	254.35b ±8.46	4.00±2.31	11012.73c± 14.81	92.69c ±0.85
T2	635.04c± 6.39	266.75b ±4.37	2.67± 1.33	11266.80cb± 18.00	95.91c0.81 ±
T3	663.48b± 5.46	290.47a ±3.42	.00	11618.89b± 14.88	101.66b±1.20
T4	711.12a± 8.04	306.91a ±4.71	.00	12276.52a± 19.44	107.41a± 1.65
Sig.	*	*	N.S	*	*

(*) The different letters in each column indicate a significant difference (p<0.05). N.S. (**) means that there are no significant differences between the averages ***Transactions (T1) were the control treatment without addition, while the second treatment (T2) was The addition of the tarzi mixture of oyster mushroom and beta-glucan was 0.5 g / ¹kg feed for the starter and 0.250 g / ¹kg feed for the final for both oyster mushroom and beta-glucan, while the third treatment (T3) the amount was 1 g / ¹kg feed for the starter and 0.5 g / ¹kg of final feed for both oyster mushroom and beta-glucan, and the fourth treatment (T4) was added to the mixture at the rate of 1.5 g / ¹kg feed for starter and 0.750 g / ¹kg feed for final for both oyster mushroom and beta-glucan.

Results in Table (7) showed that economic and performance index of the fourth treatment recorded the highest significant value (P<0.05) it were 12276.52 and 107.41, respectively, compared with control treatment, which recorded the lowest value which amounted 11012.74 and 92.69. The reason for the improvement in the values of the performance measure, the production index, the economic index, and the economic index may be attributed to the ability of oyster mushrooms to synthesize silver nanoparticles (AgNPs) that prevent the growth of pathogenic bacteria, which is reflected in the vitality of birds. Some studies showed the possibility of using the synergistic mixture as a natural antibiotic, which led to a decrease in the mortality rate, which in turn reflected positively on the value of the productive index [25], [26], explained that the improvement of the economic index scale is associated with a higher rate of Weight gain, vital ratio, and feed conversion coefficient, as these measures are directly proportional to the bird's weight gain rate ,vital ratio, and feed conversion coefficient.

4. Conclusion

The addition of the synergistic mixture of oyster mushroom and beta-glucan (1.5 g / kg) to the diet led to an improvement in the productive and economic characteristics of broiler chickens exposed to heat stress.

Compliance with ethical standards

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Disclosure of conflict of interest

The author declare no conflicts of interest.

References

[1] FAO. (2017). Status and capabilities of mushroom industry in Iran. Quarterly Journal of Mushroom. No: 11.

[2] D.Dittoe, S.C., Ricke, & A.Kiess, A. Commercial poultry production and gut function: a historical perspective. In Improving gut health in poultry (pp. 3-30): Burleigh Dodds Science Publishing. https://www.taylorfrancis.com/chapters/edit/10.1201/9780429266713-1/ 2019.

[3] E.F.Boateng, M.M. Nasiru, & M. Agyemang, M. (2020). Meat: Valuable Animal-Derived Nutritional Food. A Review. Asian Food Sci. J., vol.15,pp.9-19.2020 DOI: 10.9734/AFSJ/2020/v15i130140.

[4] M.U.Sohail, A. Ijaz, M. Yousaf, K. Ashraf, H. Zaneb, M. Aleem, & H.Rehman, (2010). Alleviation of cyclic heat stress in broilers by dietary supplementation of mannan-oligosaccharide and Lactobacillus-based probiotic: Dynamics of cortisol, thyroid hormones, cholesterol, C-reactive protein, and humoral immunity. Poultry Science, vol89, no9pp.1934-1938.2010 doi: 10.3382/ps.2010-00751.

[5] H.H.Hussein, &J.M. Jassim, J. M. The effect of Moringa oleifera leaf meal and their aqueous and ethanolic extracts on immunological parameters, and liver enzymes of broiler chickens. Basrah Journal of Agricultural Sciences,vol32,pp.272-282.2019. https://doi.org/10.37077/25200860.2019.275

[6] Habib, H. N., Karomy, A. S., Gheni, Q. J., & Saleh, W. M. M. (2020). *Molecular detected of heat shock protein70 gene in Layer hens (Lohmann breed).* Paper presented at the IOP Conference Series: Materials Science and Engineering.

[7] I.Zulkifli, N. Abdullah, N.M. Azrin, & Y .Ho,. Growth performance and immune response of two commercial broiler strain fed diets containing Lactobacillus cultures and oxytetracycline under heat stress conditions. British poultry science, vol.41,no 5,pp. 593-597. 2000.

[8] S. Rahimi, &A. Khaksafidi. A comparison between the effects of a probiotic (Bioplus 2B) and an antibiotic (virginiamycin) on the performance of broiler chickens under heat stress condition. 2006. https://www.sid.ir/FileServer/JE/102320060308.pdf

[9] E.Larsson, V. Tremaroli, Y. S . Lee,O. Koren, I. Nookaew, A. Fricker, F. Bäckhed, F. Analysis of gut microbial regulation of host gene expression along the length of the gut and regulation of gut microbial ecology through MyD88. gut, vol61, no8 pp. 1124-1131.2012.

[10] M.C.Perdomo, & R.E. Vargas,. (2004). Nutritional value of yeast (Saccharomyces cerevisiae) and its derived products, extract and cell wall, in poultry feeding. https://tspace.library.utoronto.ca/bitstream/1807/7056/1/la04011.pdf.

[11] O.Sogunle, O., Labinjo, J. Olanite, J., & A. Adebowale, (2019). Growth performance and blood profile of cockerel chickens on administration of oyster mushroom (*Pleurotus ostreatus*) in water and feed. Archivos de zootecnia, vol.68, no261pp. 24-30. 2019 https://pdfs.semanticscholar.org/3e19/d16b6f6ee37319f7164f9caadfc1d0ce4444.pdf

[12] C. Akomah, O. Sogunle, O., Adeyemi, , & A. Bamgbose . Growth performance and hematological characteristics of pullet chickens fed different feed forms supplemented with or without Oyster mushroom (*Pleurotus ostreatus*). Nigerian Journal of Animal Production, 2021. https://doi.org/10.51791/njap.v48i5.3202

[13] S.A.Saadoun,, & S.H.Timosz,. Molecular Diagnosis of oyster mushroom *Pleurotus ostreatus* and screening for resistance gene of plant pathogenic fungi Osterolysin. Al-Qadisiyah Journal of Pure Science, vol22,no3pp. 380-392.2017. https://qu.edu.iq/journalsc/index.php/JOPS/article/download/678/676/

[14] I.A. Al-Jrrah, & R.J.Abbas, R. J. (2020). Effect of Natural and Synthetic Sources of Lycopene on Productive Performance, Carcass Quality and viscera relative weights of Japanese Quail Coturnx japonica Temminck & Schlegel, 1849. Basrah Journal of Agricultural Sciences, vol33,no2 pp. 52-66. 2020.

[15] M.O.North . Commercial poultry Production manual .Westport connection Publishing Company .Inc, USA.Pp299-301.1978.

[16] S.P.Wasser,. Medicinal mushroom science: history, current status, future trends, and unsolved problems. International journal of medicinal mushrooms, Vol12, no1.2010.. Doi : 10.1615/IntJMedMushr.v12.i1.10.

[17] C.Tang, P.C. Hoo, L.Tan, P. Pusparajah, T. M .Khan,., L.H.Lee., . . . K.G.Chan,. Golden needle mushroom: a culinary medicine with evidenced-based biological activities and health-promoting properties. Frontiers in pharmacology, 7, 474. 2016. https://doi.org/10.3389/fphar.2016.00474

[18] U.N. Prakash, & K.Srinivasan, K. Beneficial influence of dietary spices on the ultrastructure and fluidity of the intestinal brush border in rats. British Journal of Nutrition, vol.104,no1 pp. 31-39.2010. https://doi.org/10.1017/S0007114510000334

[19] R.Abou-Elkhair, H., Ahmed, & S.Selim, S. (2014). Effects of black pepper (Piper nigrum), turmeric powder (Curcuma longa), and coriander seeds (Coriandrum sativum) and their combinations as feed additives on growth performance, carcass traits, some blood parameters and humoral immune response of broiler chickens. Asian-Australasian Journal of Animal Sciences, vol 27, no 6 pp.8847. 2014.

[20] S.Yahav, D. Shinder, J., Tanny, & S.Cohen,. Sensible heat loss: the broiler's paradox. World's Poultry Science Journal, vol 61, no 3,pp.419-434. 2005.https://doi.org/10.1079/WPS200453

[21] M.Sohail, M. Hume, J. Byrd, D. Nisbet, A. Ijaz, A., Sohail,., . . . H.Rehman,. Effect of supplementation of prebiotic mannan-oligosaccharides and probiotic mixture on growth performance of broilers subjected to chronic heat stress. Poultry Science, vol91,no.9.pp. 2235-2240. 2012.

[22] Z.A. Abidin, N. Khatoon, S. Arooj, S. Hussain, A. Ali, A. W. Manzoor, and M. K. Saleemi. Estimation ochratoxin A in poultry feed and its ingredients with special reference to temperature conditions. Br PoultSci 2017 https://doi.org/10.1080/00071668.2017.1293797 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4093167/

[23] A.Daneshmand, G.H. Sadeghi, & A.Karimi. The effects of a combination of garlic, oyster mushroom and propolis extract in comparison to antibiotic on growth performance, some blood parameters and nutrients digestibility of male broilers. Brazilian Journal of Poultry Science, vol14,pp. 141-147.2012.

[24] Ullah, M. I., Ijaz, M. U., Hussain, G., Faisal, M. N., Rasul, A., Bukhari, S. A., . . . Anwar, H. (2020). Estimation of Protein and Productive Efficiency Profile of Locally Produced Oyster Mushroom (*Pleurotus ostreatus*) in Broiler . https://doi.org/10.21203/rs.3.rs-71550/v1.

[25] R. Al-Bahrani, J., Raman, H. Lakshmanan, A.A. Hassan, & V.Sabaratnam,. (2017). Green synthesis of silver nanoparticles using tree oyster mushroom *Pleurotus ostreatus* and its inhibitory activity against pathogenic bacteria. Materials Letters, vol.186, pp.21-25. 2017.

[26] J.Flint, & M. Garner. Feeding beneficial bacteria: A natural solution for increasing efficiency and decreasing pathogens in animal agriculture. Journal of Applied Poultry Research, vol18,no2 pp. 367-378.2009. https://doi.org/10.3382/japr.2008-00133

[27] H.N. zu, A.S. Karomy, Q.J. Gheni, & W.M.Saleh,. 2020. Molecular detected of heat shock protein70 gene in Layer hens (Lohmann breed). Paper presented at the IOP Conference Series: Materials Science and Engineering. Doi: 10.1088 / 1757-899X / 928/6/062017

[28] National Research Council.(NRC) (1994). Nutrient Requirements of Poultry. 9th ed. National Academy of Science. Washington, D.C.: 176pp. https://doi.org/10.17226/2114.

[29] Naji, S. A., & Hanna, K. (1999). The Guide to Chickens and Bright. Arab Federation for Food Industries Printer, Heba.

[30] SPSS. (2019). SPSS User's Guide Statistics. Version 26. Copyright IBM, SPSS Inc.