The Effect of Adding Chitosan and Oxytetracycline to Wheat-Soybean Diet on The Productive Performance of Broiler Chickens

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Abstract

This experiment was conducted in the poultry farm of the Animal Production Department / College of Agriculture / Anbar University, for the period from 8/12/2019 until 23/3/2019 for (42 days). The experiment aims to compare the addition of two different levels of Chitosan and one level of antibiotic to the wheat-soybean diet and their effect on the productive performance of broiler chickens from the age of 7-42 days. The experimental treatments were T1: control (without any addition), T2: addition of 0.2 g Oxytetracycline /kg feed, T3: addition of 1 g Chitosan/kg feed and T4: addition of 2 g Chitosan/kg feed. The birds were randomly distributed to four treatments, with 3 replicates per treatment, and 12 birds for each replicate, where 144 chicks, 7 days old of Ross broiler chickens with an average weight of 168.7g were used in the experiment. The results showed that there were no significant differences in live body weight, weight increase and the relative growth rate of broiler, while significant differences occurred between treatments in the feed consumption rate during the first and fifth week and the duration from 7-21 days The T4 decreased significantly from T2 and T3, after which there was a significant decrease in the treatment of T3 from the T1 and T2 treatments in the fifth week. As for the feed conversion factor, there was no significant difference, as well as the percentage of mortality during the 7-42 days.

Keywords: Broiler, Soybean, Chitosan, Oxytetracycline.

1. Introduction

As a result of the technological advances of the poultry industry in the application of the modern nutrition programs and using genetic improvement programs that allow some lines to express their adequate genetic potential. Furthermore, it has led to producing a generation with rapid growth and low disease resistance, which leads to excessive use of antibiotics and medicinal drugs to reduce the incidence of diseases and reduce mortality [1]. The use of antibiotics in poultry diets as growth stimul has become prohibited in some countries of the European Union and the United States, which has led to thinking towards finding alternative ways to raise the body's immunity and reduce the infection with bacterial and fungal diseases [2,3]. It also has an impact on the birds health; reduce its natural resistance and the consumer health for its survival in the carcass tissues [4]. Among these means is the addition of Chitosan as a non-food additive in poultry diets as a substance that is derived from Chitin, which is not harmful to animal and human health, and is a multi-unit of glucosamine and constitutes most of the external skeleton of marine organisms such as shrimp and crabs [5]. The researchers emphasized that it has a positive effect on improving the productivity and physiological performance of broiler chickens and developing energy and protein use efficiency. It works to regulate the intestinal flora and create conditions for the proliferation of beneficial microorganisms and the prevention of harmful negative and positive microorganisms of cram stain [6-8]. Additionally, the Chitosan is an antifungal [9,10], while [11,12] were stated that the Chitosan improves the digestibility and absorption of nutrients by increasing the secretion of digestive enzymes in the stomach and intestine. In spite of the introduction of wheat in the broiler diets of imported and local, some of them do not have the conviction to include them in the diets as a result of infection with mycotoxins, and that the use of wheat in diets will contribute to reducing their cost and less exposure to mycotoxins compared to the wheat and allowing some strains of birds to express On her genetic potential [13]. the cereal sources in complete and deficient diets, particularly with Ross strains adapted to wheat-based diets, are still, uninvestigated throughout broiler production [14]. Therefore, this study aimed to understand the effect of adding the Chitosan to the wheat-soybean diet on the production performance of broiler chickens and determining the best level of addition.
2. Materials and Methods

This experiment was conducted on the poultry farm of the Animal Production Department / College of Agriculture / University of Anbar, for the period from 8/12/2019 until 23/3/2019 in (42 days). The experiment aims to compare the addition of two different levels of Chitosan and one level of antibiotic to the wheat-soybean diet and their effect on the productive performance of broiler chickens from the age of 7-42 days. Moreover, the experimental treatments were controlled treatment T1 (without any addition), the second treatment T2 includes the addition of 0.2 g Oxytetracycline/kg feed, while the T3 includes the addition of 1 g Chitosan/kg feed and T4 includes the addition of 2 g Chitosan/kg feed. The chicks were randomly distributed to four treatments, with 3 replicates per treatment, and 12 birds for each replicate, where a total of 144 chicks, 7 days old of Ross broiler chickens, with an average weight of 168.7g were used in the experiment. Three types of diets were given during the experimental period, which included (the starter diet) from the age of one day until the 11th day, the second diet (the growth diet) from day 12 to day 21 and the third diet (finisher diet) from day 22 to 42 days as shown in Table 1. Chitosan was imported from the People’s Republic of China, which was in the form of a fine white powder in a sealed envelope, not exposed to light and transported to Baghdad by air (Dalsey Hillbom Lynn, DHL). The chicks were weighed at the end of each week individually, and then the average body weight was calculated as follows:

\[
\text{Weight gain} = \frac{\text{Average body weight at the end of the week} - \text{Average body weight at the beginning of the week}}{\text{Number of live birds at the end of the week}}
\]

The feed consumption = the amount of consumed feed during the week / the number of live birds at the end of the week, and the feed conversion ratio = the amount of consumed feed / the total weight of the birds. The relative growth rate was calculated according to the method [15], and the mortality percentage = the number of dead birds / the total number of birds at the end of the week. One-way analysis was performed, and the direction consists the effect of four treatments using the General Linear Model and using the SAS Statistical 9.1 [16]. Significant differences between averages were tested using the Duncan New Multiple Range test [17] at the significance level 0.05.

**Table 1.** The diets used in the experiment and the calculated chemical composition.

| Components          | Starter diet (1-11 day) | Growth diet (12-21 day) | Finisher diet (22-42 day) |
|---------------------|-------------------------|--------------------------|---------------------------|
| Wheat               | 59.26                   | 64.34                    | 69.06                     |
| Soya bean meal      | 33.4                    | 28                       | 22.6                      |
| Pre-prepared mixtures | 2.5                     | 2.5                      | 2.5                       |
| Oil                 | 3.4                     | 4                        | 4.8                       |
| Limestone           | 0.7                     | 0.6                      | 0.6                       |
| CaHPO4              | 0.4                     | 0.3                      | 0.3                       |
| DL-Methionine       | 0.17                    | 0.15                     | 0.08                      |
| L-Lysine            | 0.17                    | 0.11                     | 0.06                      |

Calculated chemical composition

| Components          | Starter diet (1-11 day) | Growth diet (12-21 day) | Finisher diet (22-42 day) |
|---------------------|-------------------------|--------------------------|---------------------------|
| Crude protein%      | 23.84%                  | 21%                      | 19%                       |
| Metabolizable energy (Kcal/kg feeding) | 3021.9                  | 3087                     | 3174                      |
| Fibers              | 3.13                    | 3.02                     | 2.95                      |
| Fat                 | 5.34                    | 5.88                     | 6.75                      |
| Lysine              | 1.40                    | 1.24                     | 1.05                      |
| Methionine          | 0.96                    | 0.63                     | 0.53                      |
| Cysteine            | 0.61                    | 0.35                     | 0.32                      |
| Ca%                 | 2.60                    | 1.02                     | 0.95                      |
| Available p%        | 23.84%                  | 0.39                     | 0.45                      |

* Brocorn-5 special W protein concentrate produced by (WAFI BV ALBLASSERDAM HOLLAND) crude protein 40%, crude fat 5%, crude fibers 2.20%, moisture 7.13%, ash 28.32, Calcium 4.50%, phosphorous 2.65%, available phosphorous 4.68%, Lysine 3.85%, Methionine 3.70%, Methionine + Cysteine 4.12%, Tryptophan 0.42%, Threonine 1.70%, Metabolizable energy 2107, Selenium 2.30%, copper 4%.

** The chemical composition values were calculated according to N.R.C.

*** The diets were created based on the 2009 ROSS company manual.
3. Result and Discussion

3.1. Average body weight, weight gain, and relative growth rate

Table (2) shows the effect of adding Chitosan to wheat-soybean diet on live body weight ratio, as there were no significant differences between treatments in the second, third, fourth and sixth week of the experiment, while a significant decrease (P≤0.05) for treatment T3 (1 g Chitosan / kg Feed) compared to the treatment of negative control T1 and did not differ significantly with the rest of the treatments in the fifth week of the experiment and this is because Chitosan possesses a positive charge in acidic solutions because it contains a free amine group that enabled him to chemical bond with the negative charge in fat and cholesterol and negative mineral ions and proteins and other molecules large [18,19], this has been reflected in the reduction in the average live body weight [20]. [12], were not seen any significant differences in the body weight between chitosan treatments compared to the control treatment during the sixth week.

Table 2. Effect of adding Chitosan and Oxytetracycline to the wheat-soybean diet on average body weight (g) for broiler.

| Weeks    | Treatments | Average | SEM* | Significance level |
|----------|------------|---------|------|-------------------|
| 2nd week | T1 443  | T2 425  | T3 431 | T4 430  | 432 | 53.7 | N.S** |
| 3rd week | T1 896  | T2 876  | T3 854 | T4 858  | 871 | 126 | N.S  |
| 4th week | T1 1565 | T2 1479 | T3 1512| T4 1482 | 1509| 208 | N.S  |
| 5th week | T1 2319 | T2 2201 | T3 2094| T4 2204 | 2204| 335 | 0.0513 |
| 6th week | T1 3156 | T2 3084 | T3 2951| T4 2956 | 3036| 425 | N.S  |

* SEM: standard error of the mean.
** N.S.: Not significant at significant level (P≤0.05).

Table (3), which includes the effect of adding Chitosan to the diet of wheat-soybean on the rate of weight gain of broiler, indicating that there were no significant differences between treatments during the second, third, fourth and fifth weeks and cumulative periods, while a significant decrease (P≤0.05 for treatment T4 (2 g Chitosan / Kg Feed) compared to the rest of the transactions in the sixth week, and this decrease is a result of the decrease in the average body weight due to the addition of Chitosan (Table 2). [12] were not seen any significant differences in the weight gain rate between chitosan treatments compared to the control treatment.

Table 3. Effect of adding Chitosan and Oxytetracycline to the wheat-soybean diet on average weight gain (g) for broiler.

| Weeks    | Treatments | Average | SEM* | Significance level |
|----------|------------|---------|------|-------------------|
| 2nd week | T1 275    | T2 256  | T3 262 | T4 261  | 263 | 10.6 | N.S** |
| 3rd week | T1 453    | T2 451  | T3 423 | T4 428  | 439 | 35.8 | N.S  |
| 4th week | T1 668    | T2 602  | T3 657 | T4 623  | 638 | 43.2 | N.S  |
| 5th week | T1 754    | T2 719  | T3 582 | T4 721  | 694 | 82.4 | N.S  |
| 6th week | T1 837    | T2 881  | T3 852 | T4 752  | 830 | 38.5 | 0.0171 |
| 7-21 day | T1 a      | T2 a    | T3 a  | T4 b    | 703 | 40.4 | N.S  |
| 22-42 day| T1 728    | T2 707  | T3 686 | T4 690  | 703 | 40.4 | N.S  |
| 7-42 day | T1 2988   | T2 2910 | T3 2778| T4 2787 | 2866| 141 | N.S  |

* SEM: standard error of the mean.
** N.S.: Not significant at significant level (P≤0.05).

a, b, c: The different letters within a single row indicate a significant difference between the treatments at a significant level (P≤0.05). T1: control, T2: 0.2 g Oxytetracycline / kg, T3: 1 g Chitosan / kg, T4: 2 g Chitosan / kg.
Table (4) shows the effect of adding Chitosan on the wheat-soybean diet to the relative growth rate of broilers, and it is also evident that there were no significant differences between treatments for all weeks and cumulative periods except for the sixth week, as there was a significant decrease (P≤0.05) for treatment T4 (2 g Chitosan / kg feed) Compared to the T2 and T3 coefficients, and did not differ significantly with the T1 (control) treatment, due to the Chitosan susceptibility to binding to fats and proteins in the digestive system and thus the growth rate decreases [19].

Table 4. Effect of adding Chitosan and Oxytetracycline to the wheat-soybean diet on the relative growth rate for broiler.

| Weeks       | Treatments | Average characteristic | SEM* | Significance level |
|-------------|------------|------------------------|------|--------------------|
|             | T1         | T2         | T3       | T4         |                |
| 2nd week    | 89.9       | 86.2       | 87.6     | 87.5       | 87.8          | 2.09          | N.S.**       |
| 3rd week    | 67.6       | 69.3       | 65.8     | 66.2       | 67.2          | 3.62          | N.S.          |
| 4th week    | 54.2       | 51.1       | 55.5     | 53.2       | 53.5          | 2.20          | N.S.          |
| 5th week    | 38.8       | 39.0       | 32.1     | 39.2       | 37.3          | 3.61          | N.S.          |
| 6th week    | 30.5       | 33.4       | 33.8     | 29.2       | 31.7          | 1.83          | 0.0401       |
| 7-21 day    | ab         | a          | a        | b          | 135.1         | 2.65          | N.S.          |
| 22-42 day   | 111.5      | 111.3      | 110.0    | 110.0      | 110.7         | 1.95          | N.S.          |
| 7-42 day    | 179.7      | 179.1      | 178.3    | 178.4      | 178.9         | 0.960         | N.S.          |

* SEM: standard error of the mean.
** N.S.: Not significant at a significant level (P≤0.05).
a, b, c: The different letters within a single row indicate a significant difference between the treatments at a significant level (P≤0.05). T1: control, T2: 0.2 g Oxytetracycline / kg, T3: 1 g Chitosan / kg, T4: 2 g Chitosan / kg.

3.2. Feed consumption (g)

Table (5) includes the effect of adding Chitosan and antibiotic to wheat diet in feed consumption rate. There are significant differences between treatments during the second and fifth week and the period from 7-21 days. It was found that the treatment T4 (1 g Chitosan / kg feed) decreased significantly (P≤0.05) from the T2 and T4 treatments and did not differ significantly from the negative control treatment T1, followed by a significant decrease (P≤0.05) for the T3 treatment compared to the T1 and T2 treatments during the week Fifth of experience. And that the decrease in the treatment of Chitosan (2 g Chitosan / kg feed) may be due to the high wheat content of (NSP) non-starchy polysaccharides, including arbenoxaline, which works to expand the digestive organs due to the viscosity in the intestine, which requires a long time for absorption and is reflected in a reduction in the feed consumption rate [21,22]. The increased viscosity due to flatulence of Chitosan when associated with fat in the stomach and intestine[19]. [12] were not seen any significant differences in the feed consumption rate between chitosan treatments compared to the control treatment.

3.3. Feed conversion ratio (g feed / g weight gain)

Table (6) includes the effect of adding Chitosan and the antibiotic to the diet of wheat in the feed conversion factor. It is clear that there were no significant differences between the treatments in the food conversion factor during the fourth, fifth and sixth week and the cumulative periods 22-42 and 7-42 days of the experiment, while we note that there was a significant decrease (P≤0.05) for T2 and T3 compared to T1 in the second week, and significantly (P≤0.05) transactions T3 and T4 decreased compared to the negative control treatment (T1) in the third week, but from the period 7-21 days there was a decrease Significant in the feed conversion factor (P≤0.05) for treatment T3 compared to factors T1 and T4 and did not differ significantly with T2 treatment, this result is normal due to the decrease in the feed consumption rate in Table (5) and the weight increase rate in Table (3). [12] were seen a significant decrease in the feed conversion ratio for the treatments of adding Chitosan and antibiotic compared to the negative control treatment during the periods from 22-42, 7-42 days.
Table 5. Effect of adding Chitosan and Oxytetracycline to the wheat-soybean diet on (g) for broiler.

| Weeks       | Treatments | Average | SEM* | Significance level |
|-------------|------------|---------|------|--------------------|
|             | T1         | T2      | T3   | T4                 |                       |
| 2nd week    | 410        | 480     | 479  | 389                | 440                  | 22.6                 | 0.0018               |
|             | b          | a       | a    | b                  |                       |                      |                      |
| 3rd week    | 488        | 560     | 578  | 544                | 542                  | 43.2                 | N.S**                |
| 4th week    | 1044       | 1038    | 979  | 1120               | 1045                 | 54.9                 | N.S.                 |
| 5th week    | 1230       | 1213    | 1092 | 1077               | 1153                 | 66.4                 | 0.0439               |
|             | a          | ab      | bc   | c                  |                       |                      |                      |
| 6th week    | 1341       | 1409    | 1462 | 1399               | 1403                 | 84.6                 | N.S.                 |
| 7-21 day    | 899        | 1041    | 1057 | 934                | 983                  | 30.0                 | 0.0004               |
|             | b          | a       | a    | b                  |                       |                      |                      |
| 22-42 day   | 3616       | 3660    | 3530 | 3598               | 3601                 | 81.9                 | N.S.                 |
| 7-42 day    | 4511       | 4697    | 4586 | 4532               | 4581                 | 75.5                 | N.S.                 |

* SEM: standard error of the mean.
** N.S.: Not significant at a significant level (P≤0.05).
a, b, c: The different letters within a single row indicate a significant difference between the treatments at a significant level (P≤0.05). T1: control, T2: 0.2 g Oxytetracycline / kg, T3: 1 g Chitosan / kg, T4: 2 g Chitosan / kg.

Table 6. Effect of adding Chitosan and Oxytetracycline to the wheat-soybean diet on feed conversion ratio (g feed / g weight gain) for broiler.

| Weeks       | Treatments | Average | SEM* | Significance level |
|-------------|------------|---------|------|--------------------|
|             | T1         | T2      | T3   | T4                 |                       |
| 2nd week    | 1.494      | 1.879   | 1.823| 1.491              | 1.671                 | 0.104                | 0.0027               |
|             | b          | a       | a    | b                  |                       |                      |                      |
| 3rd week    | 1.079      | 1.244   | 1.372| 1.270              | 1.241                 | 0.095                | 0.0338               |
|             | b          | ab      | a    | a                  |                       |                      |                      |
| 4th week    | 1.567      | 1.723   | 1.493| 1.814              | 1.649                 | 0.169                | N.S**                |
|             | c          | ab      | a    | a                  |                       |                      |                      |
| 5th week    | 1.630      | 1.723   | 1.930| 1.494              | 1.694                 | 0.286                | N.S.                 |
| 6th week    | 1.603      | 1.601   | 1.723| 1.861              | 1.697                 | 0.137                | N.S.                 |
|             | b          | a       | a    | bc                 |                       |                      |                      |
| 7-21 day    | 1.235      | 1.473   | 1.544| 1.356              | 1.402                 | 0.071                | 0.0035               |
|             | c          | ab      | a    | b                  |                       |                      |                      |
| 22-42 day   | 1.601      | 1.668   | 1.691| 1.718              | 1.669                 | 0.116                | N.S.                 |
| 7-42 day    | 1.510      | 1.618   | 1.654| 1.628              | 1.603                 | 0.099                | N.S.                 |

* SEM: standard error of the mean.
** N.S.: Not significant at a significant level (P≤0.05).
a, b, c: The different letters within a single row indicate a significant difference between the treatments at a significant level (P≤0.05). T1: control, T2: 0.2 g Oxytetracycline / kg, T3: 1 g Chitosan / kg, T4: 2 g Chitosan / kg.

3.4. Mortality percentage

Table (7) shows the effect of adding ketosan and antibiotic to wheat diet in percentage of total mortality, no significant differences between transactions in the percentage of mortality from the second week to the sixth week of the experiment, as well as during the period 7-21 days while there was a significant increase (P≤0.05) in the percentage of mortality of the
treatment T2 (positive control) compared with the rest of the transactions during the periods 22-42 and 7-42 days of the experiment, and the reason is due to the intensive use of the antibiotic in this treatment to the bacterial growth resistant to it, which was reflected on Increased percentage of total mortality[23]. These results were not consistent with [24,25] did not find any significant differences between treatments when adding oxy-tetracycline to the diet at the level of 40 mg / kg feed and 5 mg / kg feed. [12] were not seen any significant differences in the mortality percentage between chitosan treatments compared to the control treatment.

Table 7. Effect of adding Chitosan and Oxytetrracycline to the wheat-soybean diet on mortality percentage % for broiler.

| Weeks   | Treatments | Average | SEM | Significance level |
|---------|------------|---------|-----|--------------------|
|         | T1         | T2      | T3  | T4                 |
| 2nd week| 275        | 256     | 262 | 261                |
| 3rd week| 455        | 451     | 423 | 428                |
| 4th week| 657        | 627     | 623 | 638                |
| 5th week| 754        | 719     | 582 | 721                |
| 6th week| 837        | 881     | 852 | 752                |
| 7-21 day| 728        | 707     | 686 | 690                |
| 22-42 day| 2260     | 2203    | 2092| 2097               |
| 7-42 day| 2988       | 2910    | 2778| 2787               |

* SEM: standard error of the mean.
** N.S.: Not significant at a significant level (P≤0.05).

References

[1] Swiatkiewicz, S., Arczewska-Włosek, A., and Jozefiak, D. (2014). Feed enzymes, probiotic, or chitosan can improve the nutritional efficacy of broiler chicken diets containing a high level of distillers dried grains with solubles. Livestock Science, 163, 110-119.
[2] Soltan, M. A., Shewita, R. S., and El-Katcha, M. I. (2008). Effect of dietary anise seeds supplementation on growth performance, immune response, carcass traits and some blood parameters of broiler chickens. International Journal of Poultry Science, 7(11), 1078-1088.
[3] Yonis, Reem W., Luti, Khalid J.K. and Aziz, Ghazi M. (2019). Statistical optimization of chitin bioconversion to effective chitosan in solid state fermentation by Aspergillus flavidus. Iraqi journal of Agricultural Science, 50(3). https://doi.org/10.36103/ijas.v50i3.708
[4] Al-Yaseen, Ali Abdel-Khalek and Abdel-Abbas, Mohammed Hassan, (2010). Poultry Feed. Ministry of Higher Education and Scientific Research, University of Baghdad / College of Agriculture.
[5] Qin, C., Gao, J., Wang, L., Zeng, L., and Liu, Y. (2006). Safety evaluation of short-term exposure to chitooligomers from enzymic preparation. Food and chemical toxicology, 44(6), 855-861.
[6] Chen, C.Q., Ren, Y.M. Wu, and J.H.Xue. (2000). Effect of chitosan on normal intestinal microflora of mouse. practical preventive Medicine. 7:413-414(in Chinese with English Abstract).
[7] Friedman, M., and Juneja, V. K. (2010). Review of antimicrobial and antioxidative activities of chitosans in food. Journal of Food Protection, 73(9), 1737-1761.gastrointestinal tract. Applied and Environmental Microbiology. 71: 968-978.
[8] Batista, A. C. L., Dantas, G. C., Santos, J., and Amorim, R. V. S. (2011). Antimicrobial effects of native chitosan against opportunistic Gram-negative bacteria. Microbiol J, 1, 105-112.
[9] Zheng, L. Y., and Zhu, J. F. (2003). Study on antimicrobial activity of chitosan with different molecular weights. Carbohydrate polymers, 54(4), 527-530.
[10] Rashid, F.H., Taha, A.A., Hameed,N.J. (2019). Study of Toxic heavy metal removal by different chitosan / hyacinths plant composite. jurnal asian agricultural Science, 50 (5). https://doi.org/10.36103/ijas.v50i5.809.
[11] Huang, R. L., Yin, Y. L., Wu, G. Y., Zhang, Y. G., Li, T. J., Li, L. L., and He, J. H. (2005). Effect of dietary oligochitosan supplementation on ileal digestibility of nutrients and performance in broilers. Poultry science, 84(9), 1383-1388.
[12] Jasim, Huda H. and Nafea, Husam H. (2021). Effect of Chitosan and Antibiotic Adding to Corn-Soybean Diet on the Productive Performance of Broiler Chickens. Indian Journal of Ecology 48 (13): 10-14.
[13] Abed, M. K., Razuki, W. M., & Al-Naif, H. H. N. (2018). Effects of Omitting Vitamin-Trace Mineral Premixes from Finisher Ration on Performance, Carcass Parameters and Blood Characteristics of Broilers Fed Corn-or Wheat-Based Diets. J Vet Sci Ani Health, 6(2), 205.
[14] Razuki, Waileed M., Abed, Mezhir K. and N. Al-Naif H., Hussam H.(2018).Effects of Self-Selection Diets Differing in Cereal
Source and Protein Level on Broiler Performance. Int. J. Poult. Sci., 17 (10): 479-485.

[15] Wollny, P. (2005). Beiträge zur Entstehungsgeschichte der Sammlung Düben. Svensk tidskrift för musikforskning, 87, 100.

[16] SAS. (2012). Statistical Analysis System, User's Guide. Statistical. Version 9.1th ed. SAS. Inst. Inc. Cary. N.C. USA.

[17] Duncan, D. (1955). Multiple rang and multiple F. Test, Biometrics, 11: 1-24.

[18] Mohammed, M.A., Salman, S.R., Abdulridha, W.M., (2020). Structural, optical, electrical and gas sensor properties of zro2 thin films prepared by sol-gel technique, NeuroQuantology, 18(3), pp. 22-27.

[19] Amin, Manal M. (2013). An articulate on Chitosan, Assiut Journal of Environmental Studies, (July)Issue 38.

[20] Ikekami, S., Tsuchihashi, F., Harada, H., Tsuchihashi, N., Nishide, E., and Innami, S. 1990. Effect of viscous indigestible polysaccharides on pancreatic-biliary secretion and digestive organs in rats. The Journal of nutrition, 120(4), 353-360.

[21] Bano, Rafia, and Alenzy, Monerah Juman. (2015). Role of chitosan in Health and weight Management. Sch.J.APP.Med.Sci., 3(2F):973-976.

[22] Angkanaporn, K., Choot, M., Bryden, W. L., Annison, E. F., and Annison, G. (1994). Effects of wheat pentosans on endogenous amino acid losses in chickens. Journal of the Science of Food and Agriculture, 66(3), 399-404.

[23] Salman, S.R., Hassan, H.B., Mohammed, M.A., (2018). The Hydrogen and Sulfur Surfaces Effect on the Structural and Electronic Properties of Graphene Nano Ribbon, Journal of Global Pharma Technology, 10 (6), pp. 386-392.

[24] Odore, R., De Marco, M., Gasco, L., Rotolo, L., Meucci, V., Palatucci, A. T., & Centenaro, S. (2015). Cytotoxic effects of oxytetracycline residues in the bones of broiler chickens following therapeutic oral administration of a water formulation. Poultry Science, 94(8), 1979-1985.

[25] Majeed, Nofal Jaber. (2018). Effect of the addition of oxytetracycline, bio-enhancer and citric acid to diets on productive performance and some physiological characteristics of male broilers. Master Thesis. Anbar University. faculty of Agriculture.