DRF-369
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RESEARCH ARTICLE Asian Journal of Dairy and Food Research

Addition of S-servicia Dry Yeast at Different Densities and its Effect in Some Productive Traits of Quail

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10.18805/ajdfr.DRF-369

ABSTRACT

Background: Dry yeast is considered a food additive that is used as a probiotic. In this study, it was added to the diet of quails that were raised at different densities to enhance growth and raise production performance, especially with the high density of birds per unit area.

Methods: This research was conducted in the field of poultry production, College of Agriculture and Forestry/University of Mosul, (50 days) to study the effect of adding yeast in concentrations of (0, 2, 4, 6) gram/liter of drinking water with three densities of breeding (56, 72, 88) birds/m^2 for the purpose of identifying the productive performance and some characteristics that are related to egg production for quail birds.

Result: Statistical analysis showed that:

- Average body weight, weight gain and feed consumption increased significantly with increasing the density, while the feed conversion factor decreased with the increase of egg mass at a density of 72 birds/m^2. From the other hand, the egg weight increased significantly at the density of 88 birds/m^2.
- Body weight and weight gain increased significantly with increasing the amount of the yeast added and the consumed feed decreased with the improvement in the feed conversion factor. Moreover, there was a significant increase in egg mass, both of the weight of egg, yolk, albumin, shell, egg length, height of yolk and albumin.
- The combination 72 bird/m^2 +4 gm yeast gave the best body weight, weight gain, egg mass, while the conversion factor decreased with the addition of yeast for all densities in addition to a significant increase in the weight of each of egg, yolk, albumin and the shell. The feed consumption increased significantly in the density 88 bird /m^2 with different concentrations of yeast addition.

Key words: Broiler, Density, Performance, Quail, Yeast.

INTRODUCTION

Recently, there has been an increase in the use of alternatives of the antibiotics added to poultry diets, such as enzymes, enhancers and yeast are amongst them (Zhang *et al.*, 2015). The yeast is considered as an anaerobic fungus and it reproduces either by fission or spores and its sizes vary according to the type. The yeast belongs to the Cycromycete family and it is added as growth stimuli to improve the performance of farm animals (Ozsoy *et al.*, 2018; Taleb, 2022) and enhancing the performance of the immune system. Recently, the tendency was focused on breeding quails as an additional source of protein, as it is considered a dual-purpose bird that is beneficial for maintaining the market production of meat and eggs because population increase resulted in food shortage. Therefore, has become a necessity to find solution that deal with food shortage. The quail is regarded as one of the fast-growing and productive birds, low cost, disease-resistant and it needs small areas for breeding. The female lays between 290-300 eggs per year, in addition to meat production, which provides humans with nutrients and mineral. The production increased due to the intensive breeding systems as this bird can be bred at a density of 80-100 birds/m^2 as well as its early sexual maturity at the age of 5-6 weeks. Therefore, its production cycle is considered short and economical and it is regarded as one of the ideal laboratory animals. Sound management plays an effective role in the success of the production process and it involves the correct exploitation of the area to reduce the costs of breeding and to increase the production of meat and eggs per a square meter.

Density of breeding is regarded as one of the stresses that can affect the internal environment of the birds, which is reflected in the production (Al-Hamed, 2021; Aro *et al.*, 2021). This is considered a managerial problem and therefore the objective of this study is to find a nutrition management technique that is used to eliminate the density stress via enhancing the growth and increasing the birds' immunity level using yeast with different levels of identify its effect on ameliorating burden that results from the stress of breeding.

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How to cite this article: AL-Hamed, A.M.Y. (2024). Addition of S-servicia Dry Yeast at Different Densities and its Effect in Some Productive Traits of Quail. Asian Journal of Dairy and Food Research. DOI: 10.18805/ajdfr.DRF-369.

Submitted: 3-11-2023 **Accepted:** 07-05-2024 **Online:** 04-06-2024

MATERIALS AND METHODS

This experiment was conducted in the field of animal production Department - College of Agriculture and Forestry/ University of Mosul, for (50 days) through adding dry baking yeast (S-servicia) at concentrations of 0, 2, 4, 6 g/l to the birds' drinking water at three breeding densities, which are 56, 72, 88 birds/m^2 and three replicates for each of the following combinations:

T_1: Density 56 b/m^2 + 0 gm yeast/l drinking water
T_2: Density 56 b/m^2 + 2 gm yeast/l drinking water
T_3: Density 56 b/m^2 + 4 gm yeast/l drinking water
T_4: Density 56 b/m^2 + 6 gm yeast/l drinking water
T_5: Density 72 b/m^2 + 0 gm yeast/l drinking water
T_6: Density 72 b/m^2 + 2 gm yeast/l drinking water
T_7: Density 72 b/m^2 + 4 gm yeast/l drinking water
T_8: Density 72 b/m^2 + 6 gm yeast/l drinking water
T_9: Density 88 b/m^2 + 0 gm yeast/l drinking water
T_{10}: Density 88 b/m^2 + 2 gm yeast/l drinking water
T_{11}: Density 88 b/m^2 + 4 gm yeast/l drinking water
T_{12}: Density 88 b/m^2 + 6 gm yeast/l drinking water

The experiment involved two stage: the first stage included birds with an age of (21-42 days), the second with age (36-63 days). Four hundred and thirty four quails (434) (Coturinx Coturinx) were bred in wooden cages with compartments of dimensions of 50 × 50 × 50 cm and the feed and water were provided ad-libitum in the form of grain. The fodder prepared on the recommendations of the National Research Council (N.R.C,1994) for both growth and production periods. The fodder was provided to the birds for 14 - 42 days with a protein rate of 23% and an energy level of 2922.5 kcal/kg. As for the production fodder, the period ranged between 43-70 days, with a protein rate 21.5% and an energy level of 3013.35 kcal/kg.

At the age 21-42 days, data of the body weight and feed consumption were recorded weekly and the weekly weight gain and feed conversion ratio were calculated. Then, after reaching sexual maturity in the age 42 days to 70 days, the eggs produced and their weights were recorded on a daily basis and the mass of the egg produced were calculated. Additionally, the measurements of eggs like the eggs quality, yolk weight, albumin weight, the weight and thickness of the egg shell, length and width of the egg, height of yolk and albumin, diameter of the yolk, index of the yolk and the index of the egg shape where all taken.

The aim of this study was to develop a managerial technique that can as a method and contributes to ameliorate in the stress of breeding density and three levels were tested using yeast at different levels and its effect on the production performance of the quails.

The complete randomized design (CRD) was used in the factorial experiment with two factors (3 × 4) to investigate the effect of three densities of quail breeding by adding four concentrations of yeast and the combination of the two factors using the SAS (2003) statistical package to determine the significance of differences between the averages. Also, Duncan's Multiple Range Test (Duncan, 1955) was used at a significance level ($p \leq 0.05$). The statistical analysis was performed according to the following mathematical model:

$$Yijkl = \mu + Ai + Bj + (AB)ij + eij$$

Where,

Yijkl= Value of the experimental unit, in which the intensity (i) of factor A and (j) of B was used.

RESULTS AND DISCUSSION

Table 1 shows a significant increase in the average live body weight during the weeks (5, 6, 7) for the birds bred in the densities 72 and 88 bird/m^2 compared to the density 56 b/m^2. The weight of birds in the seventh week was (275.57, 274.94 and 251.53) grams respectively and this could be due to the increase in the amount of feed consumed by the birds for the same two treatments, as shown in Table 3, because of the competitive behavior of the quail birds. These results were in agreement with the results of (Al-Tammee, 2019; Bolacali and Irak, 2017) and in disagreement with the results of (Cengiz *et al.*, 2015) and Aro *et al.* (2021), who reported that the body weight deteriorates with the increase of breeding density. Moreover, the researchers Adeyemo *et al.* (2016); Al-Flaih (2019); Boountian *et al.* (2019); Al-Hamed (2020); Al-Hamed (2021) found that density of breeding had no significant effect on the body weight.

As for the effect of adding the yeast, it was observed that the body weight increased significantly during the weeks 3,4,5,6,7 with the treatment of adding yeast at a rate of 4 g/l compared with the control and with the two additions 2 and 6 g/l as the weight in the seventh week. This concentration (rate) might be the suitable one fulfilled in intestinal environment that could achieve the highest body weight. These results were in conformity with Yusuf *et al.* (2015); Ashok *et al.* (2016) and Talib (2022), but results disagreed with the results of Al-Flaih (2019), who did not find an effect of the yeast added on this characteristic.

Results also, were not in conformity with the results of (Abd El-Wahab *et al.*, 2020), who found a significance decrease in the body weight when various concentrations of yeast (0.5, 1.5, 2.5 and 3.5%) were added to the feed.

As for the combination of the treatments: The density 72 b/m^2 + 4 g yeast gave the highest significant body weight at the seventh week of age.

Table 2 demonstrates that the weight gain increased significantly in the densities (72) and (88) b/m^2, compared to the density 56 b/m^2 for the weeks 3, 4 and 5 and also there was a significant increase in the total weight gain with values of (165.64, 166.46 and 145.3) grams respectively. This might be due to the consumption higher quantities of feed compared to the density (56) b/m^2 due to the competitive behavior in the high densities. These results are in conformity with the results of (Al-Tammee, 2019), while they were not in conformity with the results of

Table 1: Effect of adding yeast under different densities in body weight (g).

Treatment		Weeks				
		3th	4th	5th	6th	7th
The density						
56 b/m²		107.59a±11.39	162.41a±1.77	194.94c±9.12	224.87b±12.17	251.53b±9.07
72 b/m²		109.93a±10.08	159.96b±10.62	205.15b±8.88	248.18a±6.90	275.57a±34.77
88 b/m²		108.48a±12.09	158.24b±13.84	211.03a±9.12	245.43a±1.76	274.94a±14.32
The adding yeast						
Zero		110.06a±5.15	161.43ab±8.07	202.56 b ±6.34	234.93c ±16.09	259.60c±4.07
2 g/l		107.07a±8.46	155.21c±4.56	201.85b±9.24	240.30b±9.75	268.39b±21.5
4 g/l		110.78a±5.69	163.83a±1.08	208.79a±7.19	247.1a±11.66	273.74a±9.00
6 g/l		106.22a±3.22	160.34b±7.19	201.63b±10.04	235.64c±1.77	267.61b±7.57
Interaction						
Density yeast concentrate						
56 b/m²	Zero	112.0ab±9.00	158.11cde±4.67	192.16a±3087	215.0 f±10.19	245.0g±3.85
	2 g/l	106.87bcd±6.04	157.33 de±7.23	192.33a±6.77	226.11ef±6.66	260.ef±11.5
	4 g/l	109.49abc±6.18	167.03 ab±5.53	199.14cd±3.8	228.37e±11.66	247.0g±6.77
	6 g/l	102.0d±3.02	167.15 ab±5.20	196.12ed±2.77	226.ef±5.0	253.99 f ±5.46
	Zero	112.0ab±10.15	162.5 bcd±9.07	201.84c±3.33	242.92bcd±3.55	264.18de±7.18
72 b/m²	2 g/l	104. 33cd±8.40	149.0 f±3.06	201.67c±9.24	246.24bcd±6.29	271.67c±8.5
	4 g/l	113.73a±3.69	168.75 a±20.18	215.42a±5.41	262.5a±5.08	290.84a±3.21
	6 g/l	109.66abc±8.07	159.58cde±7.09	201.84c±1.84	241.0cd±3.56	275.59c±2.17
	Zero	107.8bc±3.33	163.67abc±12.87	213.84±3.64	242.8bcd±6.7	269.62cd±6.14
88 b/m²	2 g/l	110.0abc±2.51	159.29 cde±9.34	211.54ab±6.45	248.49bc±2.3	273.49c±4.6
	4 g/l	109.1abc±7.32	155.71e±5.70	211.8ab±8.11	250.43b±9.11	283.39b±6.07
	6 g/l	106.99bcd±6.11	154.28ef±6.55	206.93b±6.05	239.92d±6.67	273.25c±5.4

Values with different letters within the same column indicates significant differences (p≤0.05).

Table 2: Effect of adding yeast under different densities in body weight gain (g).

Treatment		Weeks				Total body weight gain
		3th	4th	5th	6th	
The density						
56 b/m²		54.82a±1.41	+32.53c±0.75	29.93b±0.61	28.29a±0.9	145.53b±1.1
72 b/m²		50.03b±1.32	45.19b± 1.7	43.03a±1.0	27.40a±0.8	165.64a±3.2
88 b/m²		49.76b±1.3	52.79a b±1.5	34.40b±2.3	29.51a±3.55	166.46a±2.88
The adding yeast						
Zero		50.83ab ±2.5	41.29b ±0.8	32.37b ±1.5	24.67b±1.3	149.0b±4.1
2 g/l		48.14b± 3.1	46.64a±1.8	38.45a±0.9	28.09ab±1.44	161.32a±3.32
4 g/l		53.05a±2.4	44.96a±2.44	38.31a±0.7	28.68a±1.05	165.19a±6.11
6 g/l		54.12a±3.6	41.29b±2.2	34.01ab±1.3	31.97a±0.9	161.39a±2.16
Interaction						
density		**Yeast concentrate**				
56 b/m²	Zero	46.11d±4.11	34.05ef±5.1	26.84d±1.11	26.0cd±0.7	133.0f±3.55
	2 g/l	50.46cd±3.55	35.0ef±2.33	33.78bcd±1.13	33.89ab±0.66	153.13d±4.33
	4 g/l	57.53b±2.75	32.12f±1.7	29.23cd±1.8	25.29d±0.55	144.16e±6.15
	6 g/l	65.16a±4.2	28.96f±1.6	29.88cd± 1.5	27.99abcd±1.2	151.99ed±5.57
72 b/m²	Zero	50.5cd±3.11	39.17de±1.11	41.25ab±3.17	21.26d±1.09	152.18ed±4.11
	2 g/l	44.67d±2.51	52.67ab±3.06	44.62a±8.11	25.38d±0.75	167.34bc±10.71
	4 g/l	55.02cb±3.32	46.67bc±2.18	47.08a±5.1	28.34abcd±1.66	177.11a±8.71
	6 g/l	49.92cd±5.11	42.26cd±2.31	39.6abc±2.81	34.59a±1.71	165.93bc±9.00
88 b/m²	Zero	55.87cb±3.33	50.18ab±1.71	29.01cd±1.56	26.76bcd±1.68	161.82c±5.51
	2 g/l	49.29cd±2.51	52.25ab±1.91	36.96abcd±3.32	24.99d±1.21	163.49bc±20.11
	4 g/l	46.59d±2.31	56.09a±1.09	38.63abc±1.7	32.96abc±1.08	174.28ab±9.21
	6 g/l	47.29d ±3.11	52.65ab±1.05	32.99bcd±2.3	33.33abc±1.55	166.26bc±3.26

Values with different letters within the same column indicates significant differences (p≤0.05).

(Ayoola *et al.*, 2014), (Cengiz *et al.*2015), (Yusuf *et al.*, 2015), (Al-Hamed, 2020) and (Yusuf *et al.*, 2015).

As for the effect of adding the yeast, it was noticed from Table 2 that the weight gain increased significantly in the treatments of adding the yeast with concentrations of (2, 4, 6) g/l for weeks (3, 4, 5 and 6) compared to the control group (no addition) and that was reflected in the cumulative weight gains 161.32, 165.19 and 161.39 grams compared to the value 149.0 grams of the control group. The reason could be that the yeast has enhanced the efficiency of the gastrointestinal tract and improved the intestinal environment by the beneficial single-cellular organisms, (Pourabedin *et al.*, 2014; Ozsoy *et al.*, 2018; Abd El-wahab *et al.*, 2020). So, there was an improvement in the as a result of the increased digestion and absorption (Smith *et al.*, 2014) and thus there was an improvement in weight gain. These results are in conformity with Table 4 that is relevant to the feed conversion ratio and results also agree with Al-Hamed (2020); Al-Hamed (2021) and disagree with and Abd El- Wahab *et al.* (2020) and Al-Flaih (2019). In the treatment of combination, the best overall weight gain was due to combining the density of birds 72 b/m^2 and the addition of 4 g of the yeast.

Table 3 shows that feed consumption increased significantly for the birds in the density 88 b/ m^2, compared to the densities (56) and (72) b/m^2 in the weeks (3, 4, 5 and 6) as well as an increase in the quantity of the total feed consumed and this disagree with Ayoola *et al.* (2014); Al-Hamed (2021) and Al-Hamed (2020).

In terms of adding yeast treatments, it was observed that there was a significant decrease in feed consumption when increasing the levels of the yeast added (2, 4, 6) g/l to the control for weeks (3, 4, 6) compared to the control group. It was also observed that there was a decrease in the total quantity of feed consumed as the values were (358.20, 358.84, 355.27 and 366.07) grams respectively. This result was in agreement with Alagawany *et al.* (2021) and Aro *et al.* (2021), but they were in disagreement with Yusuf *et al.* (2015) and Sharif *et al.* (2018). From the other hand, Al-Flaih (2019) did not find an effect on this characteristic when yeast was added.

With regard to the effect of the interaction, it was noted that there was a significant increase in the total of feed consumed for the interaction resulting from the density 88b/ m^2 with or without the added yeast.

Table (4) shows that the feed conversion ratio increased significantly in the density (88**)** b/m^2 compared with densities (56 and 72) b/m^2 in the third week. It also shows that there was no significant effect of density during the weeks (4, 5 and 6), while this ratio decreased significantly for the total period in the density (72) b/m^2 compared to the densities (56) and (88) b/m^2. These results

Table 3: Effect of adding yeast under different densities in feed consumption.

Treatment		Weeks				Total feed consumption
		3th	4th	5th	6th	
The density						
56 b/m^2		57.42b±1.3	72.34c±3.11	87.86c±4.25	102.65b±3.2	320.09c±3.65
72 b/m^2		52.38b±1.12	86.86b±1.96	94.63b±2.88	102.65b±4.11	332.51b±4.11
88 b/m^2		84.45a±2.12	100.17a±3.33	111.50a±4.31	119.95a±3.11	416.08a±2.67
The adding yeast						
Zero		71.93a±1.55	85.17a±2.11	96.52a±3.11	112.45a±6.2	366.07a±5.11
2 g/l		62.93 b±1.81	88.51a±3.75	97.33a±3.71	108.85ab±3.44	358.02ab±2.91
4 g/l		65.50b±5.11	86.85a±1.95	99.47a±1.99	107.03b±4.67	358.84ab±2.67
6 g/l		66.64b±1.82	85.29a±2.66	98.01a±1.56	105.33b±2.66	355.27b±3.61
Interaction						
Density		**Yeast concentrate**				
56 b/m^2	Zero	62.90d±5.84	70.00e±3.75	84.10d±4.12	110.2b±2.31	327.20de±11.65
	2 g/l	56.88de±2.67	74.86e±3.70	88.00cd±5.43	110.11b±7.13	329.85d±11.04
	4 g/l	55.40e±3.01	71.00e±2.28	88.11cd±4.33	96.30d±1.87	310.81f±2.67
	6 g/l	54.50e±2.67	73.50e±1.87	90.50cd±4.1	94.00d±3.75	312.49ef±3.31
72 b/m^2	Zero	59.99de±4.1	82.89d±3.31	93.13cb±3.66	107.5cb±1.91	343.46cd±4.61
	2 g/l	56.49de±1.5	93.33cb±3.55	94.53bc±2.44	97.12d±2.63	341.48cd±2.48
	4 g/l	58.80de±3.11	89.88c±3.11	100.30b±2.16	105.33cb±2.71	354.31c±3.4
	6 g/l	58.23de±1.88	81.37d±2.1	90.53cd±5.11	100.67cd±4.16	330.80d±2.19
88 b/m^2	Zero	92.89a±3.71	101.67a±4.11	112.33a±7.66	119.76a±2.12	427.56a±11.2
	2 g/l	75.41b±3.66	97.33ab±2.67	110.66a±3.21	119.33a±3.75	402.75b±11.12
	4 g/l	82.29b±2.92	99.96ab±3.15	110.00a±2.88	119.45a±3.81	411.41ab±8.87
	6 g/l	87.19ab±1.17	101.00a±3.44	113.0a±4.11	121.33a±4.15	422.25a±4.22

Values with different letters within the same column indicates significant differences ($p \leq 0.05$).

Table 4: Effect of adding yeast under different densities in feed conversion ratio.

Treatment		Weeks				Total feed conversion
		3th	4th	5th	6th	
The density						
56 b/m²		1.07b±0.09	2.28a± 0.01	3.07a±0.02	3.74a±0.02	2.21b±0.07
72 b/m²		1.18b±0.03	1.94b±0.09	3.07a±0.03	3.93a±0.07	2.07c±0.03
88 b/m²		1.71a±0.06	1.90b± 0.04	3.32a±0.04	4.16a±0.06	2.50a±0.12
The adding yeast						
Zero		1.41a±0.02	2.09a± 0.03	3.18a±0.03	4.62a±0.03	2.46a±0.04
2 g/l		1.32a±0.05	1.93a±0.06	2.64a±0.03	3.99b±0.03	2.22b±0.02
4 g/l		1.27a±0.02	1.99a± 0.04	2.71a±0.05	3.86bc±0.06	2.17b±0.02
6 g/l		1.29a±0.02	2.15a± 0.01	2.96a±0.02	3.32c±0.02	2.20b±0.01
Effect of interaction						
Density	**Yeast concentrate**					
56 b/m²	Zero	1.37cd±0.05	2.11b± 0.02	3.31abc±0.04	4.27abcd±0.02	2.46ab ±0.01
2 g/l		1.13def±0.02	2.14b±0.05	2.78bcd±0.03	4.27abcd±0.01	2.16de±0.03
4 g/l		0.96fg±0.02	2.25b±0.04	3.06±0.02	4.04abcde±0.03	2.16de±0.02
6 g/l		0.84g±0.01	2.61a±0.01	3.1abcd±0.02	3.38cde±0.02	2.06e ±0.01
72 b/m²	Zero	1.19def±0.03	2.13b±0.03	2.29cd±0.08	5.10a±0.02	2.26cd±0.03
2 g/l		1.27de±0.03	1.77b±0.05	2.12d±0.04	4.16a±0.06	2.04e±0.05
4 g/l		1.08efg±0.01	1.93b±0.01	3.13d±0.02	3.85bcde±0.02	2.00e±0.07
6 g/l		1.17def±0.03	1.93b±0.03	2.32c±0.06	3.85bcde±0.01	1.99e± 0.03
88 b/m²	Zero	1.66ab±0.04	2.05b±0.05	3.94a±0.02	4.48abc±0.06	2.64a±0.07
2 g/l		1.55bc±0.03	1.87b±0.03	3.0abcd±0.03	4.85ab±0.04	2.46ab±0.05
4 g/l		1.77ab±0.03	1.78b±0.04	2.92a±0.03	3.68cdf±0.07	2.36bc±0.02
6 g/l		1.85a±0.02	1.92b±0.06	3.43ab±0.04	3.65cdf±0.03	2.54a±0.12

Values with different letters within the same column indicates significant differences ($p \leq 0.05$).

Table 5: Effect of adding yeast under different densities in egg mass produced (g).

Treatment		Weeks				Total egg mass (g)
		7th	8th	9th	10th	
The density						
56 b/m²		26.17a±1.29	36.11ab±0.03	3.07a±0.02	3.74a±0.02	170.73b ±4.17
72 b/m²		27.90a±0.88	39.28a±1.62	3.07a±0.03	3.93a±0.07	179.99a±4.82
88 b/m²		27.80a±0.69	36.99b±1.84	3.32a±0.04	4.16a±0.06	171.26b±4.32
The adding yeast						
Zero		25.76b±0.78	32.13d±0.67	37.71c±0.91	57.78c±1.06	153.38c±1.42
2 g/l'		28.78a±0.57	35.70c±1.34	43.99b±0.69	66.07b±0.90	174.54b±1.54
4 g/l		30.34a±0.77	42.54a±1.13	48.39a±0.88	70.27a±1.36	191.55a±2.42
6 g/l		24.28b±1.18	39.47b±1.60	45.31b±1.33	67.44ab±1.38	176.50b±3.88
Effect of interaction						
Density		**Yeast concentrate**				
56 b/m²	Zero	24.67bc±1.2	31.67e±1.2	37.07e±1.16	57.20d±1.56	150.6e±1.39
	2 g/l	29.33a±1.45	37.5cd±1.32	42.33bcd±0.62	63.43bc±0.87	172.5cd±0.29
	4 g/l	30.00a±1.54	39.67bc±0.33	47.0a±2.38	70.49a±2.78	187.65ab±3.42
	6 g/l	20.67d±1.86	35.62cde±1.5	46.33ab±2.07	69.53ab±1.01	172.15cd ±4.6
72 b/m²	Zero	24.33c±0.88	31.33e±1.2	39.23de±1.94	60.13cd±2.05	135.03e±3.16
	2 g/l	28.5ab±0.76	38.6bc±0.70	45.42abc±1.38	67.43ab±1.27	179.95bc±1.21
	4 g/l	31.27a±1.77	42.43ab±1.57	49.10a±1.1	72.33a±3.67	195.13a±3.67
	6 g/l	27.5abc±0.7	44.77a±1.36	48.33a ±1.2	69.23ab±2.6	189.83a±3.35
	Zero	28.27ab±0.63	33.4de±1.7	36.83e±1.79	56.0d±1.53	154.5e±2.56
88 b/m²	2 g/l	28.5±1.04	31.0e±1.53	44.3abc±0.88	67.33ab±1.45	171.17cd ±2.46
	4 g/l	29.67a±1.09	45.53a±1.87	48.57a±1.27	68.0ab ±2.65	191.87a±5.43
	6 g/l	24.67bc±0.88	35.02bc±2.06	41.27cde±1.51	63.57bc±1.84	167.52d±3.02

Values with different letters within the same column indicates significant differences ($p \leq 0.05$).

were in agreement with the results of (Al-Hamed, 2020), (Al-Hamed, 2021), (Aro *et al.*, 2021) and (Al-Tammee, 2019). The feed conversion ratio rose with the increase in the density of the birds and this was in disagreement with the results of (Adeyemo *et al*., 2016) and (Alagawany *et al.*, 2021) who reported that the conversion ratio increased with the increase in the density. Ayoola *et al.*(2014) observed no effects of density on breeding the birds.

As for the effect of adding the yeast, no significant differences were observed between the treatments in the weeks (3, 4 and 5), while the total conversion ratio improved in the yeast-adding treatments (2, 4 and 6) g/l for the sixth week, as well as for the total period. This may be due to the increased utilization of the nutrients in the feed as a result of the improvement of the intestinal environment, the development of the gastrointestinal tract and the increase in digestion and absorption processes that are a consequence of the role played by the single-cell organisms in improving performance Smith *et al.* (2014) and Ozsoy *et al*. (2018). These results are in agreement with Abd El-Wahab *et al*. (2020), while they are in disagreement with the results of Yusuf *et al*. (2015), Sharif *et al*. (2018) and Al-Flaih (2019) who found no the effect of adding the yeast on this characteristic.

As for the combination treatment, it was found that the least of these combinations was the medium density 72 b/m^2 with adding 6 g of yeast as the total highest conversion coefficient resulted from the density (72) b/m^2 and without adding the yeast.

Table 5 shows that the mass of eggs produced by female quails was not significantly affected by the difference in density during the weeks 7, 9 and 10 , but it increased significantly in the total period (7-10) weeks for the density 72 b/m^2 compared to the densities (56 and 88) b/m^2. These results were in agreement with Al-Tammee (2019) and were in disagreement with Faitarone *et al.* (2005) who stated that the mass of produced eggs deteriorated with the increase of breeding density and with El-Shafi *et al.* (2012).

Additionally, it was also observed that there was a significant increase in the yeast addition treatments 2, 4 and 6) g/l compared to the control treatment. This was because one of the feed components contains digestible proteins, multiple sugars, vitamins and minerals Ozsoy *et al.* (2018); Elghandour *et al.* (2019). Results were in disagreement with the results of Yusuf *et al.* (2015).

In the combinations treatment, it was found that the mass of eggs significantly increased in the combination of the densities (72 and 88) b/m^2 and the addition of yeast with a concentration of 4 g /l to the water as the values were (195.3 and 191.87) grams and this enhances the use of yeast in high densities to exploit the unit area and to reduce the impact of stress that results from the density. On the

Table 6: Effect of adding yeast under different densities in egg weight, albumen, yolk and shell (g).

Treatment / Characters		Egg weight g	Yolk weight g	Albumin weight g	Shell weight g	Thicken shell mm
The density						
56 b/m^2		12.81b±1.09	4.42a±0.13	10.28a±1.43	1.41a±0.02	0.24a±0.001
72 b/m^2		12.99b±0.48	4.21a±0.60	7.40b±0.78	1.39a± 0.3	0.23a±0.003
88 b/m^2		15.94a±1.63	4.20a±0.12	10.29a±0.89	1.44a±0.1	0.23a±0.005
The adding yeast						
Zero		11.4c±0.88	3.29b±0.07	6.78b±0.81	1.33b±0.06	0.24a±0.007
2 g/l		13.31b±1.07	4.49a±1.30	7.41b±0.29	1.40ab±0.05	0.24a±0.003
4 g/l		15.84a±1.07	4.71a±0.41	9.64a±0.88	1.48a±0.03	0.23a±0.002
6 g/l		15.11a±1.28	4.62a±0.07	9.06a±1.03	1.43a±0.16	0.23a±0.001
Effect of interaction						
Density		**Yeast concentrate**				
56 b/m^2	Zero	11.75ef±1.12	3.56b±0.12	6.89d±0.08	1.30b±0.04	0.25a±0.001
	2 g/l	13.61cd±1.05	4.60a±0.13	7.58cd±0.68	1.43ab±0.07	0.26a±0.009
	4 g/l	14.73c±1.0	4.76a±0.36	8.47c±1.38	1.50a±0.07	0.22a±0.001
	6 g/l	11.15f±1.08	4.77a±0.05	4.98e±0.67	1.40ab±0.01	0.22a±0.003
72 b/m^2	Zero	11.62ef±0.17	3.56b±0.08	7.12cd ±0.94	1.30b±0.04	0.24a±0.005
	2 g/l	12.71de ±0.66	4.29a±0.07	7.03d±0.09	1.39ab±0.03	0.24a±0.003
	4 g/l	13.88cd±1.14	4.70a±0.15	7.75cd±1.10	1.44ab±3.67	0.22a±0.006
	6 g/l	13.76cd±0.78	4.63a±0.66	7.71cd ±0.92	1.42ab±0.04	0.24a±0.001
88 b/m^2	Zero	10.81e±0.33	3.09b±0.11	6.34d±0.89	1.38ab±0.06	0.23a±0.006
	2 g/l	13.61cd ±1.07	4.58a±0.09	7.64cd±0.88	1.39ab±0.04	0.22a±0.002
	4 g/l	18.90b±1.29	4.67a±0.12	12.70b±1.17	1.53a±0.03	0.26a±0.002
	6 g/l	20.43a±1.58	4.47a±0.14	14.49a±1.11	1.47bc±1.84	0.22a±0.005

Values with different letters within the same column indicates significant differences ($p \leq 0.05$).

Table 7: Effect of adding yeast under different densities in egg quality characteristics.

Treatment \ Weeks		Egg length mm	Egg width mm	Albumin height Mm	Youlk height mm	Yolk diameter mm	Yolk index	Egg shape parameter
Effect of density								
56 b/m^2		33.88 a±1.19	26.39 a±2.08	4.26 a±0.13	10.87 a±1.33	20.35 b±2.19	0.46 a±0.002	77.86 a ±1.13
72 b/m^2		33.04 a±0.58	25.78 a±1.48	3.99 a±0.60	10.80 a ±1.78	23.65 a±1.67	0.46 a±0.003	78.15 a±103
88 b/m^2		33.21 a±1.06	25.63 a±2.33	4.30 a±0.22	11.01 a±2.89	23.23 a±0.89	0.47 a±0.006	77.20 a±2.02
Effect of adding yeast								
Zero		32.64b±1.18	25.24a±2.71	3.92 b±1.11	10.15 b±0.85	22.44 b±1.88	0.45 a±0.003	77.39 a±1.98
2 g/l		33.44ab±1.23	26.36a±0.87	4.42 a±0.12	11.31 a ±1.39	23.89 a±1.23	0.47 a±0.005	78.78 a±1.56
4 g/l		34.11a±1.07	26.18a±1.04	4.27 a±0.11	10.92 a±1.67	24.05 a±1.17	0.45 a±0.002	76.88 a±1.66
6 g/l		33.32ab±2.33	25.94a±1.12	4.62 a±0.23	11.21 a±2.33	19.27 c±0.99	0.47 a±0.001	77.90 a±1.34
Effect of interaction								
Density	**Yeast concentrate**							
56 b/m^2	Zero	32.96ab±2.12	25.5b±1.12	3.94bcd± 0.22	9.91d±0.78	22.25c±1.4	0.45bc±0.001	77.44a±1.22
	2 g/l	34.64a±1.25	27.79a±1.13	4.04bcde±0.23	11.51ab ±1.68	24.28 ab±1.17	0.48ab±0.005	80.06a±2.32
	4 g/l	34.7a±1.66	26.5ab±2.23	4.56 ab±0.66	11.43ab ±1.12	24.22a±2.13	0.48ab±0.002	76.42a±1.31
	6 g/l	33.24ab±1.78	25.77ab±1.05	4.51abc±0.04	10.7abc±0.67	20.65d±1.34	0.44bc±0.001	77.51a ±1.11
72 b/m^2	Zero	32.9ab±1.99	25.44b±0.98	3.74e±0.04	10.07cd ±0.94	22.76bc±1.04	0.45bc±0.004	77.40a±1.11
	2 g/l	32.79ab±0.66	25.22b±1.23	3.85cde±0.15	11.34ab±1.12	23.7abc±1.07	0.48ab±0.003	76.99a±1.13
	4 g/l	33.68ab±1.54	26.07b±1.62	3.79de±0.16	10.4bcd±1.12	24.46a±0.78	0.43c±0.002	77.77a±1.16
	6 g/l	32.79ab±1.78	26.38ab±1.13	4.59ab±0.41	11.34ab ±1.41	23.7abc±1.11	0.48ab±0.003	80.46a±1.71
88 b/m^2	Zero	32.06 b±1.33	24.77b±1.12	4.09cde±0.07	10.5bcd±0.89	22.31c±1.23	0.47abc±0.006	77.32a±1.44
	2 g/l	32.89ab±2.13	26.07ab±1.15	3.89cde±0.15	11.1abc±0.83	23.7abc±1.45	0.47abc±0.002	79.30 a±1.12
	4 g/l	33.96ab±1.14	25.98ab±1.89	4.46abcd±0.12	10.9abc±1.17	23.5abc±1.67	0.46abc ±0.003	76.45 a±1.12
	6 g/l	33.93ab±1.23	25.68ab±1.62	4.76a±0.15	11.65a±1.11	23.5abc±1.99	0.50a ±0.004	75.73 a±0.79

Values with different letters within the same column indicates significant differences ($p \leq 0.05$).

contrary, it was observed that the egg mass was the lowest in all the combinations resulting from the density and without adding any amount of the yeast.

Table 6 shows that the egg weight increased significantly in the breeding density (88) b/m^2 compared to the breeding densities (56 and 72 b/m^2). Also, the weight of albumin increased significantly in the density (72) b/m^2 compared to the two densities (56 and 88 b/m^2). There was no significant effect on the weight of the yolk, the weight of shell and the thickness of the shell. These results are not in conformity with the results of Al-Hamed (2021) and Aro *et al.* (2021) who reported that the weight of eggs deteriorated with the increase of the breeding density. From the other hand, Al-Tammee (2019) stated that the weight of the egg did not affected by the breeding density.

It was observed that the weight of the egg significantly increased in the treatments that involved addition of the yeast compared to the control treatment. The weight of the yolk, albumen and shell also increased that is due to the role played by the yeast as it acts as a probiotic in terms of making use of the nutrients absorbed and also the yeast contains digestible proteins, multiple saccharides, minerals and vitamins (Alizadeh, 2016) and (Al Khalaifah, 2018). This was all reflected in the performance of the eggs produced. These results are in agreement with the results of Yusuf *et al*. (2015) but they are in disagreement with the results of Alagawany *et al.* (2021).

Moreover, it is found in Table (6) that the combination treatment (88 + 6) that results from the combination of the densities (88 b/m^2 + (6) grams of yeast, gave the highest egg weight and albumen weight. Adding the yeast with different concentrations for the three breeding densities increased the egg albumin weight white compared to the control treatment.

Table 7 shows that there is no significant effect of breeding density on both the length and the width of the egg, the height of the yolk and albumin, the diameter of the yolk and the indices of the yolk and the shape of the egg. These results were in agreement with the results of (Al-Tamee, 2019), while they were in disagreement with the results of Aro *et al*. (2021), where these characteristics increased significantly with the increase of breeding densities.

As for the combination treatment, it was observed that the longest and widest egg was obtained from the combination of the breeding density (56 b/m^2) and the addition of yeast in the two concentrations (2 and 4) g/l. Moreover, the highest value for the height of the yolk and albumin and the index of the shape of the egg were obtained from the combination of (88 bird/m^2 + 6 g/l).

CONCLUSION

The use of yeast enhanced the birds breeding at high density, as it contributed to eliminates the stress resulting from density and thus it supports the production performance. So, it is recommended to use yeast, probiotics and medicinal plants when breeding quails in high-density systems.

ACKNOWLEDGEMENT

The author is thankful for the support provided by the Department of Animal Production Dept. College of Agriculture and Forestry/University of Mosul/Iraq.

Conflict of interest

The author declare that no conflict of interest exists as far as this research is concerned.

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