ARTICLE / INVESTIGACIÓN

Effect of seeds, oil, and black seed meal on Japanese Quail's productive performance

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Abstract: The research aims to effect using seeds, oil and black seeds meal on the productive performance of Japanese Quail. Seven experimental diets were used in the study; T1 was the control (with 0% seeds, oil or black seed meal), and T2 and T3 contained black seeds (BC) at two levels, 0.80 and 1.60%, respectively. T4 and T5 black seed oil (BSO) was added at 0.50 and 1% levels, respectively, while the last two treatments, T6 and T7, contained black seed meal (BSM) at two levels of 7 and 14%, respectively. Mash feed and water were submitted *ad libitum* during the whole period. The study includes one stage; the growth period (1-35 days old). This research was conducted at a poultry farm, Animal Production Department, College of Agriculture and Forestry, University of Mosul, Mosul, Iraq. A total of 588 desert color Japanese quail (*Coturnix coturnix japonica*), unsexed at one day old, were randomly distributed in seven previous treatments of six replicates with 14 birds in each in the growth period. The results showed significant effect (p≤ 0.05) in body weight(g/bird),body weight gain(g/bird), Protein digestion coefficient(%), Preslaughter weight(g/bird), carcass weight(g/bird), for T3. While the data showed a significant effect (p≤ 0.05) for T2 in water intake. The data confirmed the superiority of the T3, T5 and T7 in carbohydrate digestion coefficient(%). The growth rate recorded a significant effect (p≤ 0.05) for T3, T4, T5 and T6. As well as, T3 reported a low significant effect (p≤ 0.05) on feed conversion ratio(g feed: g WG) and water conversion ratio(ml: g WG). The best net revenue(Iraqi Dinar: g WG) was T7 and T3. No significant differences were founded in all other traits in this study.

Key words: Seeds, oil, black seeds meal-productive performance -Japanese Quail.

Introduction

The black seed plant (*Nigella sativa* L.) is a medicinal plant, and it is a member of the Ranunculaceae family[1]; this plant is generally known as the black seed or black cumin[2]. But it is called in Arabic Habbat ALbaraka or ALhabba AL-saodaa[3,4], and the origin of this plant is in Iraq, Saudi Arabia, Syria, Turkey and Pakistan[5]. The seeds have many active compounds such as Nigellin, carvene, Thymoquinone and Thymohydroquinone[6]. These seeds also contain metabolizable energy of more than 4949 Kcal. /Kg, and also have a high percentage of ether extract, about 36.94 % and crude protein, 23.27 %. (in this study), As well as black seed oil includes a high percentage of unsaturated oil as linoleic acid, above 60 %[7]. Black seed meal also contains high levels of metabolizable energy 3186 Kcal / Kg and crude protein, about 37.94 %. (in this study) But black seeds meal contains a high level of crude fiber, more than 12.15 %. So that black seeds, black seed oil and black seeds meal are used in poultry nutrition. Therefore, the seeds, oil and meal of the black seed are used to increase the immunity of birds, improve the productive performance of growth characteristics, improve feed conversion efficiency, blood and carcass characteristics, and even economic calculations[8-16]. This study aims to use all these matters together in one research and to know the effect of Japanese Quail on some productive performance traits.

Materials and methods

The aim of this research is to study the effect of using seeds, oil and black seeds meal on the productive performance of Japanese Quail (*Coturnix coturnix japonica*). Seven experimental diets were used in the study; T1 was the control (with 0% seeds, oil or black seed meal), and T3 contained black seeds (BC) at two levels, 0.80 and 1.60%, respectively, T4 and T5 black seed oil (BSO) was added at two levels of 0.50 and 1% respectively, while last two treatments were T6 and T7 contained black seed meal (BSM) at two groups of 7 and 14% respectively. Mash feed and water were submitted ad libitum during the whole period. This study was in a single phase lasting 1-35 days. This research was conducted at a poultry farm, Animal Production Department, College of Agriculture and Forestry, University of Mosul, Mosul, Iraq. A total of 588 desert color Japanese quail (Coturnix coturnix japonica), unsexed at one day old age, were randomly distributed in 7 previous treatments of 6 replicates with 14 birds each in the growth period. The birds were housed in an iron cage 50 × 50 × 50 cm with the same condition and rearing. The rations contain about 2911-2916 kcal/kg metabolizable energy and 24.09 -24.12 % crude protein. The Nutrient requirements of growing Quail and the chemical composition of the last diets in the research were according to (17), table 1. The seeds of black seed were obtained from the local market of the city of Mosul in Iraq, while the oil and black seed meal was obtained from one of

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the factories of medicinal plant oils in the city of Mosul. The oil was obtained from the seeds by pressing a homemade press, and the rest of these seeds are the expeller black seed meal, table 2. The birds were weighed every week; then the weight gain was extracted, while the relative growth rate was calculated as found by (18), and deaths were recorded daily, and then their percentage was calculated at the end of the study, the consumed feed was calculated through the difference between the feed added and the remaining feed, as well as the efficiency of feed conversion (gm of feed: gm of weight gain). And according to the water consumption and Water conversion ratio according to (19) as follows: Water consumption(ml/bird) = water added (ml/bird) - water remaining (ml/bird), Water conversion ratio(ml: gm) = water consumption(ml/bird)/weight gain (gm/bird).

A digestion experiment was conducted to calculate the digestibility factors of dry matter, crude protein, crude fiber, crude fat and soluble carbohydrates. At the age of 35 days (end of the study), the birds were cut off feed for 6 hours before slaughter; these birds were weighed. Twenty-four birds from each treatment were slaughtered, with 12 males and 12 females from each treatment, after which the characteris-

Ingredients	T1 control	Black seed		Black seed oil		Black seed meal	
		T2 0.80%	T3 1.60%	T4 0.50%	T5 1%	T6 7%	T7 14%
Black seeds	0	0.80	1.60	-	-	-	-
Black seed oil	0	-	-	0.50	1	-	-
Black seed meal	0	-	-	-	-	7	14
Soybean meal	34	33.62	33.24	34	34	27.95	21.90
Yellow corn	50	49.88	49.76	50	50	50	50
Sunflower oil	2.50	2.20	1.90	2	1.50	1.55	0.60
Wheat bran	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Protein concentrate	10	10	10	10	10	10	10
Limestone	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Vit. Min. premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100
calculated Chemical analysis:							
ME(kcal/kg diet)	2911	2911	2911	2911	2911	2913	2916
Crude protein %	24.10	24.11	24.12	24.10	24.10	24.10	24.09
ME / P ratio	120.8	120.7	120.7	120.8	120.8	120.9	121
Dry matter %	89.94	89.95	89.97	89.94	89.94	90.29	90.62
Ether extract %	5.15	5.15	5.13	5.15	5.15	4.87	4.59
crude fiber %	4.01	4.06	4.12	4.01	4.01	4.44	4.86
Ash %	5.68	5.68	5.68	5.68	5.68	5.80	5.92
NFE %	51	50.95	50.92	51	51	51.08	51.16
Lysine %	1.51	1.51	1.50	1.51	1.51	1.44	1.38
Methionine %	0.66	0.66	0.67	0.66	0.66	0.67	0.68
Linoleic acid %	2.93	2.90	2.88	2.92	2.92	2.76	2.60
Calcium %	1.10	1.11	1.11	1.10	1.10	1.16	1.22
A. phosphorus %	0.49	0.49	0.49	0.49	0.49	0.50	0.51

* Protein concentrate (Holland Proton): include: 92.5% dry matter, 45% crude protein, 4% Ether Extract, 2.5% Crude Fiber, 14%Ash, 29% NFE, 2200 Kcal / Kg ME, 4.5% Lysine, 3.5% Methionine, 2.2%, Linoleic acid, 8% Calcium, 3.5% A. phosphorus, 0.40% sodium and 0.55% chlorine.

Table 1. The components of the research as well as the chemical analysis calculated in 1-35 days.

Items	black seeds	black seed meal
ME(kcal/kg diet)**	4949	3186
Crude protein %	23.27	37.94
Dry matter %	94.82	95.38
Ether extract %	36.94	10.22
crude fiber %	10.36	12.15
Ash %	3.85	7.11
NFE %	20.40	27.96
Lysine %	0.73	1.35
Methionine %	0.41	0.66
Linoleic acid %	19.87	5.82
Calcium %	0.70	1.13
A. phosphorus %	0.27	0.35

Table 2. Laboratory analysis of black seed and black seed meal in research.

*Determined analyzed by (23).

**ME (metabolizable energy) calculated by Bolton (24);

$$ME(Mjul/kg\ diet) = C.P\% \times 0.153 + E.E\% \times 0.345 + N.F.E\% \times 0.143.$$

tics of the carcass were recorded as stated in (20). Sensory evaluation (Tenderness, juiciness, flavor and Acceptability) of a piece of Japanese quail breast was conducted by grilling the breast meat in an electric oven at 177°C. When the internal temperature of the meat pieces reached 80°C, then the evaluation forms were submitted to arbitrators, according to the method[21]. The economic variables were calculated during the period (1-35) days to produce 1 kg of live weight, as approved by (19). The statistical program SAS[22] by using the computer, was used to analyze the data statistically for a simple experiment with one factor. It was applied by complete random design (CRD) for the significance of the differences between means, tested by Duncan's multiple range test, while the value of the standard error of these means was found.

Results

The results in Table 3 indicate the superiority of treatment 3 (1.60% black seed) significantly ($P \leq 0.05$) in the traits of body weight(BW) and body weight gain(BWG); the reason may be due to The herb's useful for reducing microbial aggregations and decreasing amino acid hydrolysis, thus, an improvement in weight gain can be seen due to the increased availability of amino acids[25].

The results of Table 5 indicate a significant superiority ($P \leq 0.05$) of treatment 3 in the digestion coefficient of crude protein and treatments 3, 5 and 7 in the coefficient of digestibility of soluble carbohydrates.

The results of table 6 show that there are no significant differences ($P \leq 0.05$) for all biochemical blood traits, but these results confirmed that treatment 3 had the highest rate in total protein, albumin and globulin, and treatments 4, 3 and 2 had the highest rates in total cholesterol, HDL cholesterol, and LDL cholesterol, respectively.

Table 9 presents the results of economic feasibility for the production of 1 kg of body weight for the period from 1 to 35 days; it is noticed from this table that the value of the intake feed costs decreased when adding 1.6% of the black seeds (26) and (30), as well as adding 7 or 14% of the black seed meal (4) and (31). As for the other costs, they decrease with all the additions (4) and (31). While the value of the total costs return to lower in the same order as the value of the intake feed costs 4, 30,31. Concerning revenue, its value is the selling price of 1 kg of the live body weight of the bird, which is 9000 Iraqi dinars(ID) for all treatments (4,15) and (31). The best net revenue value and best % net revenue: Total costs for the transaction were for treatment 3, treatment 7, and treatment 6.

Discussion

The results of these two traits, body weight(BW) and body weight gain(BWG), were similar to the results of (25), when feeding a growing Japanese quail with black seeds, (26-28) when they used broilers in their studies. At the same time, the results of this study differed with (8,13,29,30); they fed broilers with different percentages of black seeds. As for the moral superiority ($P \leq 0.05$) of quail birds in the growth rate(GR) characteristic, it went to treatment 3(1.60% black seed) than treatments 4, 5(0.50 and 1% black seed oil) and 6(7% black seed meal), The reason of that growth rate is calculated using body weight at the beginning and end of the study period, meaning that it depends entirely on body weight, and this is a reflection of the result of body weight, these results agreed with (31). When the broiler was fed

Treatments	BW (g/bird)	BWG (g/bird)	GR (%)	MR (%)
T1: Control 0%	181.32bcd ± 2.24	173.30bcd ± 2.24	183.07b ± 0.32	3.57 ±3.57
T2: BS 0.80%	173.97d ±3.12	165.95d ± 3.10	182.36b ± 1.56	0 ± 0
T3: BS 1.60%	207.89a ±3.89	199.87a ± 3.89	192.28a ± 3.35	0 ± 0
T4: BSO 0.50%	177.98cd ±2.74	169.97cd ± 2.73	191a ± 1.02	1.19 ± 1.19
T5: BSO 1%	184.94bc ±22.5	176.92bc ± 2.50	191.33a ± 2.97	0 ± 0
T6: BSM 7%	185.15bc ±1.97	177.13bc ± 1.95	191.33a ± 2.81	1.19 ± 1.19
T7: BSM 14%	188.57b ±1.55	180.57b ± 1.54	188.37ab ± 1.63	2.38 ± 1.51

Table 3. Effect of using seeds, oil and black seed meal on body weight, weight gain, growth rate and mortality rate in this study 1-35 days.

Treatments	FI (g/bird)	FCR (g feed: g gain)	WI (ml/bird)	WCR (ml: g gain)	WI: FI (ml: g feed)
T1: Control 0%	517.58 ±5.89	2.99ab ±0.06	1482.35ab ±7.79	8.55ab ±0.07	2.86 ±0.04
T2: BS 0.80%	521.42 ±7.15	3.14a ±0.08	1495.38 a ±12.31	9.01a ±0.24	2.87 ±0.04
T3: BS 1.60%	504.75 ±4.75	2.53d ±0.07	1409.50 d ±24.13	7.05d ±0.12	2.79 ±0.03
T4: BSO 0.50%	511.06 ±1.43	3.01ab ±0.04	1456.71bc ±20.88	8.57ab ±0.13	2.85 ±0.01
T5: BSO 1%	510.20 ±1.28	2.88bc ±0.04	1430.86cd ±15.23	8.09bc ±0.19	2.80 ±0.04
T6: BSM 7%	515.24 ±5.836	2.91bc ±0.02	1447.18c ±33.37	8.17bc ±0.10	2.81 ±0.03
T7: BSM 14%	507.17 ±6.02	2.81c ±0.01	1427.13cd ±14.46	7.89c ±0.14	2.81 ±0.06

Vertically different letters for each adjective differ significantly from each other (P<0.05). BC: black seeds, BSO: black seed oil, BSM: black seed meal, FI: feed intake, FCR: feed conversion ratio, WI: water intake, WCR: water conversion ratio.

Table 4. Effect of treatments on some feed and water traits 1-35 days.

with the different pedigree of the black seed meal, While it is not similar with (4), by offering different percentages of black seed meal to two strains of broilers. Finally, in Table 3, there were no significant differences (P ≤ 0.05) in the mortality rate(MR) for all treatments. This result is in line with the results of (30,32,33) After feeding broilers with different levels of black seeds and (34) Feed broilers with black seed oil. At the same time, this result did not agree with black seeds, (27,36,37) with black seed meal.

The significant decrease (P ≤ 0.05) indicated the superiority of treatment 3 in feed conversion ratio(FCR) g feed: e gain and water conversion ratio(WCR) ml: g gain, which is shown in Table 4, This may be the reason for this superiority in the first adjective(FCR) because the FCR is calculated by dividing the amount of feed intake by the body weight gain, and in this study, this treatment has the highest body weight gain with a scientific difference and has the lowest rate of feed intake with an arithmetic difference, while the reason

Treatments	DM %	CP %	CF %	EE %	NFE %
T1: Control 0%	70.35 ±3.77	c 68.61 ±2.31	24.67 ±1.11	72.20 ±3.21	bc 80.54 ±5.21
T2: BS 0.80%	70.35 ±2.46	c 68.44 ±4.54	23.75 ±0.31	72.38 ±4.22	c 80.25 ±0.14
T3: BS 1.60%	71.06 ±5.77	a 71.85 ±5.30	24.33 ±0.93	73.77 ±5.21	an 86.20 ±11.01
T4: BSO 0.50%	71.06 ±2.57	c 68.75 ±12.91	23.67 ±2.04	72.03 ±2.30	bc 80.67 ±7.11
T5: BSO 1%	70.75 ±9.37	bc 69.72 ±1.41	24.67 ±3.11	73.51 ±4.21	an 84.35 ±5.71
T6: BSM 7%	71.96 ±4.65	bc 69.85 ±7.91	24.35 ±1.11	73.20 ±1.51	ab 84.11 ±5.23
T7: BSM 14%	71.65 ±2.07	ab 70.98 ±6.33	24.67 ±1.71	73.20 ±4.78	an 85.90 ±8.41

Vertically different letters for each adjective differ significantly from each other ($P<0.05$). BC: black seeds, BSO: black seed oil, BSM: black seed meal, DM: dry matter, CP: crude protein, CF: natural fiber, EE: ether extract, NFE: nitrogen-free extract.

Table 5. Treatments effect In the digestion coefficients of some feed compounds for the diets at 1-35 days.

Treatments	TP (g/100ml)	ALB (g/100ml)	GLO (g/100ml)	TC (mg/100ml)	HDL (mg/100ml)	LDL (mg/100ml)
T1: Control 0%	4.31 0.08±	2.35 0.03±	1.96 0.04±	168.32 3.21±	68.93 2.33±	99.39 2.05±
T2: BS 0.80%	4.49 0.07±	2.33 0.04±	2.16 0.03±	168.35 4.21±	68.18 1.58±	100.17 3.11±
T3: BS 1.60%	4.98 0.12±	2.57 0.05±	2.41 0.03±	165.06 4.38±	71.42 5.12±	93.64 5.33±
T4: BSO 0.50%	4.55 0.10±	2.37 0.03±	2.18 0.03±	167.79 6.21±	70.31 2.33±	97.48 3.15±
T5: BSO 1%	4.68 0.09±	2.41 0.08±	2.27 0.05±	166.52 4.80±	70.90 1.95±	95.62 4.67±
T6: BSM 7%	4.65 0.09±	2.43 0.04±	2.22 0.05±	167.32 5.21±	69.96 3.33±	97.36 4.11±
T7: BSM 14%	4.80 0.13±	2.42 0.04±	2.38 0.04±	166.22 3.34±	70.03 5.33±	96.19 5.02±

Vertically different letters for each adjective differ significantly from each other ($P<0.05$). BC: black seeds, BSO: black seed oil, BSM: black seed meal, TP: Total Protein, ALB: Albumin, GLO: Globulin, TC: Total Cholesterol, HDL: HDL Cholesterol, LDL: LDL Cholesterol.

Table 6. Effect of treatments In some biochemical blood traits at 35 days.

Treatments	PSW (g/bird)	CW (g/bird)	DP (%)	BP (%)
T1: Control 0%	170.80bc ±1.37	121.53bc ±2.15	71.15 ±1.46	31.97 ±0.53
T2: BS 0.80%	162.02c ±0.90	112.26d ±2.25	69.29 ±1.22	30.22 ±0.42
T3: BS 1.60%	198.16a ±5.76	146.21a ±1.75	73.78 ±2.71	33.64 ±1.85
T4: BSO 0.50%	164.53c ±2.96	114.47cd ±0.58	69.57 ±1.03	31.90 ±1.38
T5: BSO 1%	175.72bc ±2.84	127.33b ±2.16	72.46 ±0.75	32.04 ±0.06
T6: BSM 1%	175.78bc ±7.04	128.16b ±2.70	72.91 ±4.39	32.33 ±0.70
T7: BSM 14%	178.56b ±4.28	130.25b ±5.14	72.94 ±3.63	32.33 ±1.38

Vertically different letters for each adjective differ significantly from each other ($P<0.05$). BC: black seeds, BSO: black seed oil, BSM: black seed meal, PSW: preslaughter weight, CW: carcass weight, DP: dressing percentage, BP: breast percentage.

Table 7. Treatments affect some carcass traits at 35 days.

Treatments	Tenderness	Juiciness	Flavor	Acceptability
T1: Control 0%	1.73 ±0.05	1.73 ±0.09	1.73 ±0.08	1.80 ±0.12
T2: BS 0.80%	1.87 ±0.06	1.73 ±0.07	1.73 ±0.10	1.87 ±0.14
T3: BS 1.60%	1.87 ±0.07	1.87 ±0.12	1.73 ±0.12	1.80 ±0.09
T4: BSO 0.50%	1.73 ±0.05	1.60 ±0.10	1.60 ±0.09	1.67 ±0.04
T5: BSO 1%	1.67 ±0.08	1.60 ±0.13	1.60 ±0.10	1.67 ±0.09
T6 : BSM 7%	1.93 ±0.05	1.67 ±0.10	1.73 ±0.15	2 ±0.21
T7 : BSM 14%	2 ±0.14	1.93 ±0.13	1.93 ±0.13	1.93 ±0.16

Vertically different letters for each adjective differ significantly from each other ($P<0.05$). BC: black seeds, BSO: black seed oil, BSM: black seed meal.

Table 8. Effect of treatments on some sensory meat taste at 35 days.

Treatments	Intake feed Costs*	Other costs *	Total costs *	Revenue *	Net revenue *	%Net revenue : Total costs
T1: Control 0%	1997	1023	3020	9000	5980	198.01
T2: BS 0.80%	2126	965	3091	9000	5909	191.04
T3: BS 1.60%	1762	920	2682	9000	6318	235.57
T4: BSO 0.50%	2259	978	3237	9000	5763	178.04
T5: BSO 1%	2385	932	3317	9000	5683	171.33
T6: BSM 7%	1858	972	2830	9000	6170	218.02
T7: BSM 14%	1748	943	2691	9000	6309	234.45

BC: black seeds, BSO: black seed oil, BSM: black seed meal. *Iraqi Dinars/Kg body weight.

Table 9. Treatments effect on some economic feasibility (Iraqi Dinar/kg BW) 1-35 days.

of second adjective(WCR) may be because the WCR is calculated by dividing the amount of water intake by the body weight gain, and in this study, this treatment has the highest body weight gain with a scientific difference and has the lowest rate of water intake with a scientific difference, The results of FCR were similar with (38), (27) and (28) but this results did not look like with (39) and (40). In the same table, Treatment 2 had the highest significant difference ($P \leq 0.05$) in water intake(WI) between treatments; the reason for this difference may be because the birds consume an amount of water equivalent to approximately 2-3 times the amount of feed intake under normal conditions. The birds of this treatment consumed the highest amount of feed, but with arithmetical differences. No significant differences ($P \leq 0.05$) were recorded for the other traits in this table; the result of feed intake was similar to (4,9,14,27,29,39,40 and 41). However, it was not identical with (12,15,30 and 31). Whereas the reason for the superiority of the digestion coefficient of crude protein is that the increase in the rate of black seeds in the diet reduces the number of harmful bacteria in the intestines of birds (25) and (33), this leads to decreasing amino acid hydrolysis; thus, an improvement in weight gain can be seen due to the increased availability of amino acids[25], from the direction. Also, the increase in the percentage of black seeds leads to an increase in the concentration of total protein in the blood serum of these birds[11,12,15,16,30,32,36-39]. Thus it is constantly available to benefit from it to build tissues and cells of the body, and this indicates a good digestion coefficient of crude protein in the ratio. And the reason of the second adjective maybe back that increasing the percentage of black seeds reduces the concentration of glucose in the blood serum of the birds of these treatments[30,32,39], and this means the use of large amounts of glucose sugar in building cells and tissues of the body, which means an increase in the coefficient of digestion of dissolved carbohydrates, from the direction. What confirms this is a decrease in the concentration of total cholesterol and an increase in the concentration of HDL in the blood serum of the birds of these treatments[10,15,32,38]. The results of the protein digestion coefficient differed with (26) and (32). Total protein, albumin and globulin results were confirmed by (30) but not approved by (32). Total Cholesterol, HDL, and LDL results were also similar to (39) but not identical to (10). In table 7, Treatment 3 recorded a significant difference ($P \leq 0.05$) in preslaughter weight(PSW) and carcass weight(CW); the reason for the superiority of this treatment in these two characteristics, it is the highest body weight and significant difference[20], Which showed that there is a direct relationship between body weight and carcass weight. Since treatment 3 had the highest final body weight with a significant difference, this was reflected in the preslaughter weight. The results of these two traits were not similar (30) and (36); the results of the other transactions in the table did not record significant differences.

While the results in Table 8 did not record significant differences ($P \leq 0.05$) in sensory meat taste, the results confirm an arithmetic improvement for treatment 5 in tenderness and treatments 4 and 5 in juiciness, flavor and acceptability, not all of these results match results of (4).

Conclusions

The best feed addition from Black seed, Black seed oil and Black seed meal was T3 at 1.60 % Black seed because it has the best final body weight (g/bird); weight gain (g/bird), and feed conversion ratio (g feed: g weight gain). As well as best carcass weight (g/bird) and dressing percentage(%) . Finally this treatment has higher net revenue (Iraqi Dinar/Kg body weight).

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