



Effect of Magnetic Drinking Water and Both of Feed Form and Feed Restriction on Sasso Broilers I. Productive Performance

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Key words: DBWG, DWC, FCR, magnetic water, Sasso broiler

Abstract: The experiment was conducted to evaluate the effect of using the magnetic drinking water and both of the form and feed restriction on the broilers (Sasso strain) chick's performance: Body Weight (BW), Daily Body Weight Gain (DBWG), Daily Water Consumption (DWC), Daily Feed Consumption (DFC), Feed Conversion Ratio (FCR) and Mortality Percentages (MR) of the whole experimental period. A total number of 1600 chicks unsexed Sasso broiler was used, divided into eight Treatments with two replicates for each treatments, in factorial experimental design $2 \times 2 \times 2$ by two replicates. The results of present study for the whole experimental period, showed highly significant differences ($p \leq 0.001$) between water treatments on BW at 8 weeks of age, since, the birds drank magnetic water has heavier BW than those drank ordinary water. Also, feed form and restricted diet had significant differences on Sasso broiler BW, since, those fed crumble diet or fed *ad libitum* has heavier weight than those fed pellet diet or fed 90% amount of feed. The results of DBWG showed significant difference between all treatment studied, since, magnetic water, crumble diet and *ad libitum* feeding has the superiority in that respect. Magnetic water and *ad libitum* feeding reduce significantly ($p \leq 0.001$) DWC values while the effect of feed form in that respect was insignificant. The only significant differences ($p \leq 0.001$) of DFC values was found between feeding treatments, since, those fed *ad libitum* has higher DFC (80.99 g) than those fed 90% amount of diet (70.63 g). The results of FCR indicated highly significant differences between water treatments, since, those drink magnetic water have better FCR values compared with those drink ordinary water. Feed form has insignificant differences in respect of FCR values, both forms has equal value (2.31), however, feed restriction has highly significant better FCR value (2.21) than those fed

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ad libitum (2.41). In respect of MR, magnetic water treatment has significant ($p \leq 0.05$) higher MR than those drink ordinary water. Feed forms have insignificant effect

on MR while the feed restriction has highly significant ($p \leq 0.01$) better MR value (2.06%) than *ad libitum* feeding (3.44%).

INTRODUCTION

Water is a major component of plants and animals and is the main medium for biochemical reactions. Using water magnetization has recently risen in different fields such as medical, engineering and agriculture, particularly in plant, animal and poultry production^[1], lead to change the functions of organism^[2]. Moreover, water magnetization changes water properties which becomes more energized, active, soft and high pH toward slight alkaline and free of germs^[3]. Several reports are available on the application of water magnetization on broiler production^[4]. Rona^[5] found that using magnetic drinking water for chickens resulted in shortening of fattening period of broiler chickens, an increase in growth rate by 5-7%, improving meat quality, flavor and tenderness as well as a decrease in feed intake and an improve in feed conversion ratio^[6].

On the other hand, different types of feed forms have been evolved in commercial broiler production at the present time. Broiler chicks can attain 2 kg body weight within 35 days, consuming only 3 kg feed^[7]. The increase of feed intake is perhaps the single most important factor determining feed efficiency of broiler^[8]. The physical form of feed is mash, pellet and crumble, for different age of birds, is a critical factor in meat yield of broiler. The feed consumption differed significantly among broiler fed different form diets^[9]. However, the feed forms are important factor which directly influence the cost of production of broiler.

Dietary manipulation methods (feed restriction) play an important role in controlling the broiler growth. Plavnik and Hurwitz^[10] defined the physical or quantitative feed restriction as provide a calculated quantity of feed per bird which is often just enough to meet maintenance requirements. In general, it can be defined as constrain due to the need to weight feed on a daily basis. There are many dietary methods for feed restriction physical (quantitative) feed restriction, skip-a-day feeding, reducing hours of illumination feeding^[11] or the diet dilution, chemical and use of low protein or low energy and energy to protein ratio^[12].

The current study was carried out to evaluate the effect of using the magnetic drinking water and both of the form and feed restriction on the broilers (Sasso strain) chick's performance.

MATERIALS AND METHODS

A total number of 1600 chicks one day old of unsexed Sasso broiler with an average initial weight was

40.0±2.0 g were used in this experiment. The study included eight groups of treatments with two replicates for each treatments (16 pens) in factorial experimental design 2×2×2 (two types of water treatments by two diet forms and two types of amount of feed) by two replicates. All birds were randomly divided in each pen. The birds were randomly allocated to eight treatments combinations: T1 birds drink magnetic water and fed *ad-libitum* crumble diet, T2 birds drink magnetic water and fed 90% amount of crumble diet, T3 birds drink magnetic drinking water and fed *ad-libitum* pellets diet, T4 birds drink magnetic water and fed 90% amount of pellets diet, T5 birds drink ordinary water and fed *ad libitum* crumble diet, T6 birds drink ordinary water and fed 90% amount of crumble diet, T7 birds drink ordinary water and fed *ad-libitum* pellets diet and T8 birds drink ordinary water and fed 90% amount of pellets diet. Birds in each replicate were kept in a partition (pens) of 5 m² space, 2.5 m long and 2 m width (20 birds/m²) from one day up to 21 days of age, after that (10 birds/m²) from 22 days up to the end of the experimental period, reared on the floor bedded with dry wood shavings provided with 6 cm height. Sasso broiler was provided with fresh Magnetic Water Treatment (MWT) every 12 h following the recommendations of the magnetic funnel manufacturer, produced by Delta water company (Web site: <http://www.deltawater.net/>). Also as reported by Khudiar and Ali^[13]. The magnetized water can be kept in a reservoir for 0-12 h but over this range, its advantage may be lost^[14]. Magnetic water treatment provided from 1-10 day-old via. inverse hand-fill drinkers (4 L) then the bigger capacity (8 L) were used tills the end of the experimental period (56 days of age). At 8 days of age until the end of the experimental period, the restricted birds (T2, T4, T6 and T8) received 90% of the quantity consumed by the broilers fed *ad libitum* (T1, T3, T5 and T7) on the previous day^[15,16]. The chicks were brooded on floor brooder at a starting temperature of 31.1°C for the first week and then decreased gradually 1-3°C every two days to reach 26:28°C until the end of the experimental period. The partitions without fans and has one window for each partition. The chicks were exposed to continuous lighting (24 h per day), one lamp 40 watt for each pen until the end of the fattening period. Two experimental commercial diets were used in this study, the first diet was starter diet used from 1-20 day of age, contained 23.37% crude protein and 3041.07 Kcal metabolizable energy ME/kg and the second was fattening diet used from 21 day till the end of the experimental period (56 days of age), contained 21.28% crude protein and 3068.37 Kcal

ME/kg, water was available all the time; also all birds were kept under similar management conditions. The studied traits were: individual weekly Body Weight (BW), Daily Body Weight Gain (DBWG), Daily Water Consumption (DWC), Daily Feed Consumption (DFC), Feed Conversion Ratio (FCR) and Mortality Rate (MR). These traits calculated for the whole experimental period (1-56 days of age).

Data were analyzed using SAS^[17] for statistical analysis program. Before analysis, all percentages data were transformed to their corresponding arcsin angles according to Snedecor and Cochran^[18]. The significant tests for the differences between each two means for any studied trait were done according to Duncan^[19].

RESULTS AND DISCUSSION

Body Weight (BW): The BW results (Table 1) noted significant higher BW for those drink magnetic water, fed crumble diet or fed ad libitum (1914, 1900 and 1940 g, respectively) over those drink ordinary water, fed pellet diet or fed 90% amount of feed (1838, 1865 and 1826 g, respectively).

The improvements obtained with magnetic water in the present study for Sasso broiler BW are in line with the pervious findings by Rona^[5] and Tyari *et al.*^[20]. Al-Fadul^[21] reported that magnetization of the water significantly increased Arbor Acres broiler BW especially in the late weeks. However, other researchers found that

the use of magnetic water did not influence the performance of chickens^[22, 4]. The differences results among studies in this field may be due to broiler strain, the magnetizer device type, power of magnetization, speed of the device, experimental procedures, etc.

The present results confirm the previous finding results, observed the superiority of weights for broiler chicks fed crumble diet^[23, 24] or crumble-pellet diets^[25, 26] over other forms studied. In contrast, Rierson^[27] reported that Cobb 500 male broilers fed a pelleted diet had significantly better performance than those fed crumbles. These differences among studies may be due to strain of bird, the feed process procedures, the specifications of different forms (physically and their composition), particle size (degree of grinding), etc.

The present results showed that the feed intake of 90% feed reduce significantly 56-day Sasso broiler BW which are line with the findings of Omosebi *et al.*^[28], Nassef *et al.*^[29], Trocino *et al.*^[16] and Adeyemi *et al.*^[30] with different broiler strains, types and duration of feed restriction. Early feed restriction had insignificant or a low impact on broiler body weight as stated by Saber *et al.*^[31] and Rahimi *et al.*^[32]. However, Rokeshi and Jafari^[15] found that early quantitative feed restriction improved the productive parameters which allow a complete recovery of broiler body weight. The inconsistent results and the variation in literature within this field may be partially due to differences in strain, management, method, timing, severity and duration of feed restriction applied.

Table 1: The effects of magnetic Water (W), Feed forms (F) and feed Restriction (R) treatments on Sasso broiler body weight, daily body weight gain, daily water consumption traits (M±SE) during the whole experimental period

Parameters	56-d Body weight (g)	Daily Body weight gain (g/bird/day)	Daily water consumption (milliliter/bird/day)
Effects			
Water treatments (W)			
Magnetic water	1914 ^a ±11.58	33.5 ^a ±0.21	211.50 ^a ±1.77
ordinary water	1838 ^b ±11.98	32.2 ^b ±0.21	218.63 ^b ±1.24
Feed forms (F)			
Crumbles	1900 ^a ±11.40	33.2 ^a ±0.20	215.63±1.67
Pellets	1865 ^b ±12.55	32.6 ^b ±0.22	214.50±1.88
Feed Restriction (R)			
<i>ad-libitum</i>	1940 ^a ±12.01	33.1 ^a ±0.21	211.88 ^a ±1.14
90% amount of feed	1826 ^b ±11.45	31.9 ^b ±0.20	218.25 ^b ±1.92
Significance			
W	***	***	***
F	*	*	NS
R	***	***	***
Interactions			
MW×C×ad	1951 ^b ±18.60	34.2 ^{ab} ±0.33	207.50 ^a ±2.02
MW×C×R	1883 ^d ±21.53	32.9 ^b ±0.39	222.50 ^c ±1.44
MW×P×ad	1980 ^a ±26.88	34.7 ^a ±0.49	209.50 ^a ±0.29
MW×P×R	1817 ^c ±25.42	31.8 ^c ±0.45	206.50 ^a ±0.87
OW×C×ad	1869 ^d ±38.59	32.7 ^b ±0.71	212.50 ^{ab} ±0.87
OW×C×R	1840 ^e ±20.47	32.2 ^c ±0.36	220.00 ^{bc} ±1.15
OW×P×ad	1900 ^c ±20.38	33.3 ^b ±0.36	218.00 ^b ±0.58
OW×P×R	1767 ^f ±22.85	30.9 ^d ±0.41	224.00 ^c ±2.31
Significance			
W × F × R	*	*	***

MW = Magnetic Water; C = Crumbles; ad = ad-libitum; OW = Ordinary Water; P = Pellets; R = 90% amount of feed; * = Significant at $p \leq 0.05$; *** = Significant at $p \leq 0.00$; NS = Not Significant; ^{a-c} Means having different letters in the same column and effect indicating significant differences ($p \leq 0.05$)

Considering the second order interactions (Table 1), the birds drink magnetic water and fed *ad libitum* pellet diet has significant ($p \leq 0.05$) highest 56-day BW (1980 g) while the birds drink ordinary water and fed 90% amount of pellet feed has the lowest (1767 g) ones.

Generally, the feed restriction method applied in the current study (continuous 90% of feed during 8-56 days of age) obviously affected the final BW of Sasso broilers and this effect was negatively higher with those drink ordinary water than those drink magnetic water.

Daily Body Weight Gain (DBWG): The DBWG results (Table 1) noted obviously significant higher DBWG for those drink magnetic water, fed crumble diet or fed *ad libitum* (33.5, 33.2 and 33.1 g, respectively) over those drink ordinary water, fed pellet diet or fed 90% amount of feed (32.2, 32.6 and 31.9 g, respectively).

The improvements found in the present study for DBWG of Sasso broiler as a result of drinking magnetic water are in line with the pervious findings by Al-Fadul^[21], Nada *et al.*^[33], Gholizadeh *et al.*^[34] and Tyari *et al.*^[20]. Magnetic water did not influence the performance of broiler chickens as found by Al-Mufarrej *et al.*^[22] and Alhassani and Amin^[4].

The diet form played an important role on the broiler growth performance, the present results support the previous results observed the superiority of weights for broiler chicks fed crumble diets^[23, 24] or crumble-pellet diet^[25, 26] over other forms studied. However, the studies of Maertens *et al.*^[35] observed the superiority of final weights for broiler chicks fed pellet diets during different stage of fattening period over those fed mash form. Rierson^[27] with Cobb 500 male broilers and Amer^[36] with Sasso broiler, reported that pellet diet feed had significantly better performance than those fed crumbles.

The present results showed that the 90% of *ad libitum* feed intake in the present study reduce significantly 1-56-day DBWG which are line with the findings of Jalal and Hana Zakaria^[37], Nassef *et al.*^[29] and Trocino *et al.*^[16] with different types and duration of feed restriction. Feed restriction had insignificant or a low impact on broiler body weight as stated by Saber *et al.*^[31] (2011) and Rahimi *et al.*^[32].

Considering the second order interaction, the birds drink magnetic water and fed *ad libitum* whatever crumble or pellet diet has higher DBWG during 1-56 days of age (34.2 and 34.7 g, respectively) while those drinks ordinary water and fed 90% amount of pellet diet has the significant lower (30.9 g) ones.

These results recommends that pellet or crumble diet fed *ad libitum* can use with magnetic water to obtain higher Sasso broilers DBWG values throughout the grow-out period.

Daily Water Consumption (DWC): The birds drink magnetic during 1-56 days of age had highly significant ($p \leq 0.001$) lower DWC value (211.50 mL) than those drink ordinary water (218.63 mL). The birds fed crumble diet had higher insignificant DWC value (215.63 mL) than those fed pellet diet (214.50 mL). The birds fed 90% amount of feed consumed highly significant ($p \leq 0.001$) more DWC (218.25 mL) than those fed *ad libitum* (211.88 mL).

The present results showed that magnetization of water reduced significantly water consumption of Sasso broiler chickens which confirms the pervious results of Al-Mufarrej *et al.*^[22] and Al-Fadul^[21]. The reduction of water intake for the birds consumed magnetized water could be explained by the interpretations of Al-Mufarrej *et al.*^[22] and McMahon^[38], since, they attributed the decrease in water intake to the changes in water properties such as surface tension, fluidity, absorbency, pH level and dissolving capabilities.

Lal and Atapattu^[39] reported that broiler water intake was not significantly affected by the dietary physical form, it being 478 and 502 mL per day during 28-42 days old for mash and pellets, respectively. However, Huang *et al.*^[40] found that the broilers feed intake on fines and mash was much lower than pellets, resulting in lower water intake.

The present results of DWC values were in line with the findings of Mench^[41] and D'Eath *et al.*^[42], whom reported that overdrinking has been reported in feed-restricted chickens. Although, Morrissey *et al.*^[43] found that birds fed on a skip-a-day regime drank more than control birds only around feeding time and much less on off-feed days and so did not seem to replace feed with water. In contrast, Huang *et al.*^[40] noted that the average daily water intake for 0-42 days was significantly higher on *ad libitum* than on restricted feeding, an observation which could be related to higher feed intake.

The second order interaction among treatments studied showed highly significant ($p \leq 0.001$) effect on DWC values during 1-56 days of age. Generally, the birds drink magnetic water and fed pellet diet whatever *ad libitum* or restricted feed has the lowest DWC (209.50 and 206.50 mL, respectively). Also, the lowest DWC value were observed for those drink magnetic water and fed *ad libitum* crumble diet (207.50 mL). The differences among the later three types of interaction groups were insignificant. The birds drink magnetic water and fed restricted crumble diet or those drink ordinary water and fed restricted pellet diet has the highest DWC values (222.50 and 224.00 mL, respectively).

These results indicate that magnetic water was more effective with pellet form more than with crumble form in decreasing DWC. The results of DWC increased in feed restriction groups, except for those drink magnetic water and fed pellet diet.

Table 2: The effects of magnetic Water (W), Feed forms (F) and feed Restriction (R) treatments on Sasso broiler daily feed consumption, feed conversion ratio, mortality rate traits (M±SE) during the whole experimental period

Parameters Effects	Daily feed consumption (g/bird/day)	Feed conversion ratio 1-56 days	Mortality rate (%)
Water treatments (W)			
Magnetic water	74.60±2.03	2.23 ^a ±0.04	3.27 ^b ±0.51
ordinary water	77.01±2.27	2.38 ^b ±0.06	2.22 ^a ±0.37
Feed forms (F)			
Crumbles	76.05±2.24	2.31±0.06	2.98±0.56
Pellets	75.56±2.16	2.31±0.04	2.51±0.34
Feed Restriction (R)			
<i>ad-libitum</i>	80.99 ^b ±1.06	2.41 ^b ±0.04	3.44 ^b ±0.45
90% amount of feed	70.63 ^a ±0.95	2.21 ^a ±0.04	2.06 ^a ±0.41
Significance			
W	NS	**	*
F	NS	NS	NS
R	***	**	**
Interactions			
MW×C×ad	79.65 ^c ±1.05	2.34 ^d ±0.04	5.52 ^f ±0.78
MW×C×R	69.55 ^a ±0.35	2.11 ^a ±0.01	2.53 ^c ±1.46
MW×P×ad	79.95 ^c ±2.25	2.31 ^d ±0.07	2.01 ^b ±0.01
MW×P×R	69.25 ^a ±0.55	2.18 ^b ±0.02	3.02 ^d ±0.01
OW×C×ad	82.95 ^c ±2.85	2.54 ^d ±0.09	2.52 ^c ±0.01
OW×C×R	72.05 ^b ±3.55	2.24 ^c ±0.11	1.34 ^a ±0.48
OW×P×ad	81.40 ^d ±3.20	2.45 ^e ±0.10	3.69 ^e ±0.97
OW×P×R	71.65 ^b ±2.45	2.31 ^d ±0.08	1.34 ^a ±0.48
Significance			
W×F×R	*	*	**

MW = Magnetic water; C = Crumbles; ad = ad-libitum; OW = Ordinary Water; P = Pellets; R = 90% amount of feed; * = Significant at $p \leq 0.05$; ** = Significant at $p \leq 0.01$; *** = Significant at $p \leq 0.001$; NS = Not Significant; ^{a-c} Means having different letters in the same column and effect indicating significant differences ($p \leq 0.05$)

Daily Feed Consumption (DFC): The Sasso broiler chicks drink magnetic water or fed pellet diet (Table 2) consumed insignificant lower daily feed (74.60 and 75.56 g, respectively) during 1-56 days of age than those drink ordinary water (77.01 g) or fed crumble diet (76.05 g). The Sasso broiler chicks fed restricted amount of feed during 1-56 days of age consumed highly significant ($p \leq 0.001$) lower daily feed amount (70.63 g) than those fed *ad libitum* (80.99 g). Normally, the applied continuous and severe feed restriction throughout the experimental period in the present study affected DFC trait.

The insignificant differences results of DFC between Sasso broiler drink magnetic or ordinary water confirms the previous findings with broiler chickens by Al-Fadul^[21], Nada *et al.*^[33], Gholizadeh *et al.*^[34] and Alhassani and Amin^[4].

The results confirm the previous finding results, observed the superiority of weights for Sasso broiler chicks fed crumble diet (Table 1). Chehraghi *et al.*^[24] and Amer^[36] showed that birds consumed pellet form diet had highest values in that respect over those fed either crumble or mash diets. Lv *et al.*^[26] observed that Ross 308 fed the crumble-pellet diets had higher average daily feed intake ($p \leq 0.01$) than those fed the mash diet. Pelleted diets had higher significant feed intake than those fed mash diets^[44-46].

The results showed that the feed intake of 90% feed in the present study reduce significantly 56-day Sasso

broiler BW which are line with the findings of Adeyemi *et al.*^[30] with different broiler strains, types and duration of feed restriction.

The second order interactions among the three treatments in that respect showed significant ($p \leq 0.05$). The birds drink ordinary water and fed *ad libitum* crumble feed consumed highest significant amount of feed (82.95 g) during the whole experimental period while the birds drink magnetic water and fed 90% pellet or crumble diet consumed significant lower feed (69.25 g).

The results of Table 2 indicated that magnetic water decrease significantly DFC of Sasso broilers over those drink ordinary water whatever they fed crumble or pellet feed. Also, feed restriction results obtained reveals a highly significant decrease in DFC throughout the experimental period which caused highly significant ($p \leq 0.001$) reduction in BW, DBWG of Sasso broiler chickens (Table 1). Therefore, it is suggested to reduce the applied quantity feed restriction method, for its benefits and to increase DFC which give the opportunity for compensatory growth.

Feed Conversion Ratio (FCR): The FCR values of water treatment showed highly significant ($p \leq 0.01$) better values for those birds drink magnetic water or those fed restricted feed (2.23 and 2.21, respectively) than those drink ordinary water or fed *ad libitum* (2.38 and 2.41, respectively), the feed form effect being insignificant in that respect (Table 2).

The present results confirm the previous findings by Al-Fadul^[21] and Nada *et al.*^[33] whom found that FCR of broiler chickens was improved by magnetization of water. However, the water magnetic treatment exhibited no significant differences for FCR trait as showed by Al-Mufarrej *et al.*^[22] and Alhassani and Amin^[4].

The crumble or pellet diets showed better FCR than mash diet as found by Zohair *et al.*^[47], Amer^[36] and Shabani *et al.*^[46]. Feed restriction improved FCR in the present study and has been well documented by Mehmood *et al.*^[48], Adeyemi *et al.*^[30] and Rokeshi and Jafari^[15]. However, feed restriction seemed to be insufficient to markedly improve the FCR^[46].

The second order interactions among treatments for Sasso broiler FCR was significant ($p \leq 0.05$), the chicks drink magnetic water and fed 90% amount of crumble diet has significant better FCR value (2.11) while the chicks drink ordinary water and fed *ad libitum* crumble diet has significant highest FCR value (2.54, worst value). The differences in FCR between those drink magnetic water and fed *ad libitum* pellet diet and those of corresponding group drink the ordinary water were 2.31 and 2.45, respectively with significant differences between them (Table 2). These results indicated that magnetic water improved FCR of Sasso broilers and this positive effect was for both forms studied. Also, the results showed, in general, the superiority for the birds fed restricted feed over those fed *ad libitum* in that respect, except for those fed restricted pellet diet. With support of the previous conclusion, the restricted pellet diet associated with drinking magnetic water obtained significant better FCR value (2.18) than those of corresponding group drink ordinary water (2.31). The same trend was observed with those fed crumble diet (2.11 and 2.24, respectively). On the other wards, the improvement in FCR of Sasso broilers fed 90% of pellet or crumble diet was due to drinking magnetic water and of course with their low feed consumption.

Mortality Rate (MR): The MR values showed significant better values for those Sasso broiler ordinary water ($p \leq 0.05$) or those fed restricted ($p \leq 0.01$) diet (2.22 and 2.06%, respectively) than those drink magnetic water or fed *ad libitum* (3.27 and 3.44%, respectively) the feed form effect being insignificant in that respect (Table 2).

Gholizadeh *et al.*^[34] stated that magnetic water increase livability of broiler chickens. However, the result of Alhassani and Amin^[4] showed that it has being insignificant effect. Despite the present result of water treatment for MR values, the both values are within the normal level for commercial broiler production. Generally, broiler mortality usually peaks at approximately 3 to 4 days after placement, declines until approximately day 9 or 10 then stabilizes until

approximately day 30 and after day 30 a gradually increase is observed until approximately day 40-45. After day 45, mortality rates increased until harvest^[49]. According to Heier *et al.*^[50], the average weekly cumulative mortality during the first week was 1.54 and 0.48% a week during the remainder of the grow-out period.

The feed form results of MR support the previous findings pointed out by Attia *et al.*^[51], Chehraghi *et al.*^[24] and El-Hammady *et al.*^[52] that no significant effect of feed form on mortality rate. On the other hand, some drawbacks of pelleted diets have been pointed out^[53,47]. Also, Broiler chickens fed mash diet had a significantly lower mortality rate than birds fed pellet^[47]. Also, Amer *et al.*^[45] found that Sasso broilers fed mash diet has significantly lowest mortality rate (5.10%) during 1-8 weeks of age than those fed crumble (9.80%) or pellet (8.09%) diet.

The feed restriction results of MR are in agreement with the previous findings by Mehmood *et al.*^[48], that feed restriction has positive effect on mortality rate. The *ad libitum* feeding affected broiler chickens; they become obese and suffer thermal discomfort, a high incidence of lameness and high mortality due to skeletal disorders and heart failure^[54]. Moreover, feed restriction has a positive effect on a significant protective effect against necrotic enteritis^[55].

The second order interaction among treatments studied showed highly significant ($p \leq 0.01$) effect on MR values. Generally, the birds drink ordinary water and fed 90% amount of crumble or pellet feed has significant lowest equal MR values (1.34%, for both) during the whole experimental period.

Whereas, the birds drink magnetic water and fed *ad libitum* crumble diet and those drink ordinary water and fed *ad libitum* pellet diet has significant highest MR value (5.52, 3.69%, respectively). These results indicate that feed restriction method applied in the present study affected positively MR trait (lower values) especially with those drinking ordinary water. However, the feed form has fluctuated manner of effect with water and feed restriction treatments.

CONCLUSION

The results of current study indicate a remarkable performance of magnetized water and might be suggested to use it as drinking water for Sasso broiler chicks while both of studied feed forms produced nearly the same performance. However, although the feed restriction applied in the present study had a slightly lower performance than *ad libitum* feeding but the continuity and severity should be alleviated. Further studies needed with magnetic water on other commercial broilers strains.

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