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Water intake of chicken broilers on supplementing sodium sulphate and fish oil in fish meal free ration

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Abstract
The present experiment analyzed the effect of supplementation of Sodium Sulphate (SS) and Fish Oil (FO) in fish meal free ration on the water intake of chicken broilers. One hundred and eighty day-old straight run broiler chicks were used on a completely randomized design in four groups with three replicates, each consisting of 15 broilers. The treatments included the T_0 group (negative control), T_1 group (control), T_2 group (T_0 + 0.35% SS) and T_3 group (T_0 + 0.35% SS + FO). Standard management practices were followed during the entire experimental period of 42 days. The results obtained regarding water intake of the broilers showed significant (p<0.05) increase in total water intake of T_2 and T_3 group as compared to control group during whole experimental period. Through this experimentation, it can be concluded that the supplementation of Sodium Sulphate with Fish Oil proved useful for improving water intake without any adverse effect on performance of chicken broilers.

Keywords: Broilers, fish meal, fish oil, sodium sulphate, water intake

1. Introduction
As per BAHS (2019) [3], total poultry population of country is 851.81 million out of which 534.74 million is commercial poultry and 317.07 million is backyard poultry. Poultry sector in India is valued at about Rs. 1,75,000 and the country has exported 2,55,686.93 MT of poultry products to the world for the worth of Rs. 453.53 Crores/58.66 USD Millions during the year 2020-21 (APEDA, 2021) [1]. Broilers play a significant role in augmenting the economic and nutritional status of varied population. Indian broiler industry experiences the rapid climb driven by increase in per capita consumption. The impressive growth within the poultry industry and especially in broiler sector is mainly a result of technological breakthroughs in breeding, feeding and health. Other factors favoring chicken consumption are increasing employment levels and incomes; a growing demand for ready-to-eat products; a rise in the number of quick-service establishments and a general preference for poultry over other meats on a price basis and in some instances cultural and non-secular reasons.
Feed represents the major cost of broiler industry but increasing cost of feedstuffs is hampering its rapid progress. About 95 percent of total feed is prepared to meet energy and protein requirements, about 3 to 4 percent for major minerals, trace minerals and vitamins requirements, and 1 to 2 percent for other feed additives. So it becomes essential to provide balanced and cost effective feed for further betterment of broiler industry.
Fish meal is one very good source to meet out the deficiency of some essential amino acids like lysine and methionine. During worldwide COVID pandemic, not only prices of fish meal increased but also availability and quality issues aggravated. Therefore, searching of alternates to fish meal becomes necessary. For this study, SS and FO were chosen based on previous literature. 0.1% Sodium Sulphate can effectively replace 18% of recommended methionine (Rahimi *et al*., 2005) [15]. Fish meal can be replaced via supplementing methionine and sodium sulphate in the full fat soya ration without affecting cost of production (Himanshu *et al*., 2008) [11]. Incorporation of sodium sulphate and methionine in all vegetable rations replaces fish meal in vegetable protein diet of broiler diet (Vidhyadharan *et al*., 2006 and Akpet *et al*., 2009) [18, 2]. Fish Oil (FO), an important source of omega-3 polyunsaturated fatty acids (PUFA) has several advantages like reduction in the rate of feed passage along with enhanced absorption of nutrients from GI tract.
Water, nearly 70% of a chicken's total weight is the major intracellular as well as extracellular component of the cell contributing to the cellular homeostasis. Water not only play a vital role

in multiple physiological processes that occur throughout the body but also assists in the transportation glucose, amino acids, vitamins, minerals and hormones. Finally, it aids in the excretion of waste products particularly urea), anti-nutritional factors ingested with the diet, drugs and drug residues. Drinking behavior is closely associated with feed intake, such that factors affecting feed consumption will indirectly influence water intake. Due to this, daily water consumption makes an excellent litmus test for the overall health and condition of a flock (Dozier *et al*., 2002, Manning *et al*., 2007) [8, 12]. Higher sodium content of diet led to higher water intake without affecting growth of chicken broilers (Mushtaq *et al*., 2005) [13]. Therefore, the present study was planned to investigate effect of SS and FO on water intake of chicken broilers.

2. Materials and Methods

The present investigation was conducted in the poultry shed of the Department of Livestock Production Management, College of Veterinary Sciences, Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hisar. The experiment was approved by the Institutional Animal Ethics Committee of Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar (Haryana). (Registration No.-1669/GO/ReBiBt-S/Re-L/12/CPCSEA).

For the present study, 180 day-old broiler chicks of Ven-Cobb strain-400 were purchased from a reputed local hatchery and randomly distributed into 4 treatment groups using Completely Randomized Design (CRD). Each treatment group consists of 45 chicks and each group was further divided into three replicates of 15 chicks each. These treatment groups were T_0-Basal ration feeding without Fish Meal (NEGATIVE CONTROL GROUP), T_1-Basal ration feeding with Fish Meal (CONTROL GROUP), T_2-Basal ration feeding without Fish Meal + 0.35% SS and T_3-Basal ration feeding without Fish Meal + 0.35% SS + FO (in place of vegetable oil).

All feed ingredients, additives and supplements used in the experiment for diet formulation were procured at once before the start of the experiment. Diets of each treatment group was formulated for three growth periods i.e. pre-starter, starter and finisher as per BIS (2007) [4] to meet out the metabolizable energy (ME), crude protein and essential amino acids (lysine, methionine) requirements of birds. The composition of the pre-starter, starter and finisher rations is as given in Table 1.

Table 1: Composition of experimental diets (% DM basis)

Ingredients	Quantity											
	Pre-starter (0-1 weeks)				Starter (2-3 weeks)				Finisher (4-6 weeks)			
	T_0	T_1	T_2	T_3	T_0	T_1	T_2	T_3	T_0	T_1	T_2	T_3
Maize	55	54	54	54	55.2	55.2	54.65	54.65	58	58	57.35	57.35
Soyabean meal	23	20	26.15	26.15	23	19	23	23	13.7	10	13.5	13.5
Ground nut cake	18	14.5	15	15	16	12.8	16	16	20.3	17	20.8	20.8
Fish meal	-	7	-	-	-	7	-	-	-	7	-	-
Mineral mixture	2	2	2	2	2	2	2	2	2	2	2	2
Sodium Sulphate	-	-	0.35	0.35	-	-	0.35	0.35	-	-	0.35	0.35
Vegetable oil	2	2.5	2.5	-	3.8	4	4	-	6	6	6	-
Fish Oil	-	-	-	2.5	-	-	-	4	-	-	-	6

The experimental chicks were reared under strict hygienic conditions. Chopped wheat straw was used as litter material. Regular raking of the litter was done so as to avoid any lump formation. Birds were vaccinated against F_1 strain of Ranikhet/Newcastle disease (NCD) on 0 day and Infectious Bursal Disease (IBD) disease on 14th day through intranasal route. Standard managemental practices including brooding, proper lighting, raking of litter, cleaning of feeders, waterers, etc. were followed throughout the experiment.

The chicks were provided *ad libitum* clean drinking water at all times through the plastic waterers. For first three days, weighed amount of jaggery is added in the Luke warm drinking water as a antistress management measure. After 3rd day, the drinking water was supplemented with a hepatoprotective liver tonic and vitamin supplement. After a period of three weeks, grower waterers were provided till the end of the experiment. Each pen had a separate 10 litre water container initially. In the last 2 weeks due to high water intake, two waterers were placed. Daily water offered and daily left over water was measured and on the basis of this water intake parameters were calculated.

Data obtained were subjected to statistical analysis as per Snedecor and Cochran (1994) [17] using Completely Randomized Design (CRD). All the data were subjected to one way ANOVA using the SPSS software (version-16). The mean differences among different treatments were separated by Duncan's multiple range tests. Consequently, a level of (p<0.05) was used as the criterion for statistical significance (Duncan, 1955) [9].

3. Results and Discussion

The effect of SS and FO on mean weekly water intake of broiler chicken is presented in Table 2. The mean weekly water intake of T_3 and T_2 was significantly higher (p<0.05) than T_1 at all weeks except during 6th week where T_1 recorded significantly higher water intake than T_2 group. The mean weekly water intake of T_3 group was significantly higher than T_2 group during 4th and 6th week but it varied vice-versa during 1st and 2nd week. Also, there was insignificant variation in weekly water intake between T_2 and T_3 during 3rd and 5th week.

Table 2: Effect of SS and FO on mean weekly water intake (ml/bird) of chicken broilers

TT	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
T_0	$231.16^{c}\pm0.44$	$529.12^{a}\pm1.03$	$1549.28^{b}\pm4.16$	$1563.22^{a}\pm1.39$	$2344.64^{b}\pm6.16$	$2553.69^{d}\pm5.19$
T_1	$212.86^{a}\pm0.17$	$645.08^{b}\pm3.69$	$1506.55^{a}\pm3.64$	$1850.36^{b}\pm11.66$	$2256.03^{a}\pm5.15$	$2293.38^{b}\pm7.24$
T_2	$228.39^{c}\pm1.08$	$753.89^{d}\pm2.90$	$1559.14^{b}\pm14.39$	$1925.52^{c}\pm7.80$	$2655.69^{c}\pm7.28$	$2118.37^{a}\pm18.68$
T_3	$219.56^{b}\pm1.47$	$729.91^{c}\pm4.59$	$1565.91^{b}\pm7.41$	$2016.10^{d}\pm7.47$	$2647.2^{c}\pm12.66$	$2430.31^{c}\pm15.34$

The effect of SS and FO on mean daily water intake of broiler chicken is presented in Table 3. The mean daily water intake of T_3 was significantly higher ($p<0.05$) than T_1 at all weeks except during 6th week where T_1 recorded significantly higher water intake than T_3 group. Also, at all weeks the mean daily water intake of T_2 group was significantly higher ($p<0.05$) than T_1. The mean daily water intake of T_2 group was significantly higher than T_3 group during 1st, 2nd and 6th week but was significantly higher in T_3 group during 4th week. However, no insignificant variation in mean daily water intake was recorded between T_2 and T_3 during 3rd and 5th week.

Table 3: Effect of SS and FO on mean daily water intake (ml/bird) of chicken broilers

TT	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
T_0	33.02c±0.06	75.58a±0.15	221.32b±0.59	223.32a±0.19	334.95b±0.88	364.81d±0.74
T_1	30.41a±0.02	92.15b±0.53	215.22a±0.52	264.34b±1.66	322.29a±0.74	327.63b±1.03
T_2	32.63c±0.15	107.69d±0.41	222.73b±2.06	275.07c±1.11	379.38c±1.04	302.62c±2.67
T_3	31.37b±0.21	104.27c±0.66	223.70b±1.06	288.01d±1.06	378.17c±1.81	347.18a±2.19

An almost similar trend like that of mean weekly and mean daily water intake was noticed in mean cumulative water intake of broiler birds due to SS and FO supplementation (Table 4). The mean cumulative water intake was significantly higher ($p<0.05$) of T_3 and T_2 group as compared to T_1 throughout the experiment except during 1st week T_1 showed significant higher water intake than T_3 but was varying insignificantly with T_2 group. As far as cumulative water intake of T_3 and T_2 group is concerned, it was significantly higher in T_3 group during 4th and 6th week, significantly higher in T_2 group during 1st and 2nd week and was varying non-significantly during 3rd and 5th week.

Table 4: Effect of SS and FO on mean cumulative water intake (ml/bird) of chicken broilers

TT	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
T_0	$231.17^{c}\pm0.44$	$760.28^{a}\pm1.29$	$2309.57^{a}\pm3.17$	$3872.79^{a}\pm4.41$	$6217.43^{a}\pm2.04$	$8771.13^{a}\pm5.18$
T_1	$212.86^{a}\pm0.17$	$857.94^{b}\pm3.60$	$2364.49^{b}\pm7.23$	$4214.86^{b}\pm10.16$	$6470.89^{b}\pm5.53$	$8764.27^{a}\pm4.06$
T_2	$228.39^{c}\pm1.08$	$982.29^{d}\pm2.53$	$2541.42^{c}\pm14.35$	$4466.94^{c}\pm10.90$	$7122.63^{c}\pm6.92$	$9241.00^{b}\pm18.71$
T_3	$219.56^{b}\pm1.47$	$949.47^{c}\pm6.03$	$2515.38^{c}\pm13.42$	$4531.49^{d}\pm20.83$	$7178.69^{c}\pm33.49$	$9609.01^{c}\pm31.02$

Comprehensively, it can be interpreted that water intake of broiler birds was improved by supplementation of SS as well as combination of SS and FO. Addition of various salts to the diet and/or drinking water alters the bird's osmotic balance and can increase water consumption and excretion to maintain water balance in the body (Borges *et al.*, 2004b) [7]. Borges *et al.* (2003, 2004a) [5] and Mushtaq *et al.* (2005) [13] reported a linear increase in water intake in heat-stressed broilers with increasing dietary Na content. These results might be due to the rich content of omega-3 fatty acids (eicosapentaenoic) (EPA) and docosahexaenoic acid (DHA) in fish oil. These fatty acids are well known as essential nutrients for health and important for numerous normal body functions. Water intake increased significantly with increasing level of fish oil which is concordant with previous findings (Elzobier *et al.*, 2016) [10]. This difference may be due to composition of fatty acids in water.

4. Conclusion

From the results of the present experiment, it can be concluded that the supplementation of SS and FO proved useful for improving water intake when it was supplemented for the period they were reared, which was 42 days under the present study.

5. Acknowledgement

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6. Declaration of conflict of interest

The authors declare that there is no conflict of interest.

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