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Evaluation of Phytogenic Mixture on Water Intake Indices in caged Broilers

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ABSTRACT: Availability of potable water is limited and is becoming lower in present day. A huge amount of water is utilised by livestock and poultry sector which creates a direct or indirect competition with human needs for availability of water. This study was conducted to evaluate the effect of phytogenic feed mixture on water intake and different efficiency ratios of utilization of water. For this experiment, 48 straight run Cobb 400 broiler chicks of same body weight were randomly distributed into three comparable groups viz. Control (no supplementation), T_1 (0.25% phytogenic mixture) and T_2 (0.5% phytogenic mixture). Each group contained 16 birds in 4 cross 4 replication. This study continued for 28 days. Results of this study showed that there was non- significant ($P>0.05$) effect of phytogenic mixture on water intake in broilers. However, there was significant ($P<0.01$) improvement of in water intake per unit feed intake, body weight, and body weight gain than control group broilers. It can be concluded that supplementation of phytogenic mixture in broilers may not adversely increase or decrease water intake. In addition to this, supplementation of phytogenic mixture (@0.25% and 0.50% of feed) improved different efficiency ratios of utilization of water for feed intake, body weight, and body weight gain than control group broilers.

Keywords: Broilers, phytogenic mixture, water intake, water efficiency ratios.

INTRODUCTION

It is certain that the demand for food and water will rise as the human and animal population is rising sharply. Poultry industry is considered as one of the most growing agriculture sector of whole world (Adbhai *et al.,* 2019; Singh *et al.,* 2021a; Singh *et al.,* 2021b; Nair *et al.,* 2022; Singh *et al.,* 2022). According to an estimation (FAO, 2019), human population may become 10 billion by the end of 2050. Similarly, the animal population will also rise to cope up with the food demands of human. These continued growths will increase competition for the fresh water resources. More than two third of surface of Earth is covered with oceanic water which is unfit for human and animals' usage. Fresh water availability is limited and has been estimated to be around 49000 cubic kilometres. Furthermore, agriculture sector consumes more than 70% of fresh water alone. It is a noticeable aspect that livestock sector consumes around 11000 cubic kilometres of fresh water annually (Ringler *et al.,*2010; Deutsch *et al.,* 2010; Opio *et al.,* 2011; FAO, 2017; Singh *et al.,* 2020; Kansal *et al.,* 2021; Singh *et al.,* 2022). Hence, judicial usage of fresh water resource becomes necessary for sustainable livelihood of both human and animals.

Water is considered as most essential nutrient for living animal. Poultry birds are considered to be very sensitive towards water supplied to them (Hafez and Attia 2020). Water intake in poultry birds, especially inbroilers, may be affected by several factors including environmental conditions, animals' health, watering managements, feed quality and quantity and water quality and quantity (Fairchild and Ruiz 2009; Khosravinia, 2016). Overconsumption and under consumption of water is not recommended. Overconsumption may lead to diarrhoeal problem and under consumption may retard growth and other physiological mechanisms of birds (Butcher *et al.,*1999; Gerbens-Leenes *et al.,* 2013; Orakpoghenor *et al.,* 2021). Some studies suggest that water intake may act as effective indicator for well being of broilers (Dozier *et al.,* 2002; Manning *et al.,* 2007; Dei, 2021; Sekh and Karki 2022).

Phytogenic feed supplementation to enhance the production performance of poultry is in great attention these days (Shahbazi and Heidari 2015; Nagar *et al.,*2020; Nagar *et al.,* 2021; Thakur *et al.,* 2020a; Thakur *et al.,* 2020b) however, we found that studies done on water intake in broilers fed on phytogenic

supplementation is very scanty. To the author's knowledge, there is no confirmative study for the effect of phytogenic supplementation on water indices of broilers. Therefore, this study was formulated to assess the impact of dietary supplementation of phytogenic mixture on water indices of broilers.

MATERIALS AND METHODS

Approval from animal experimentation committee

This research study was conducted after the approval of animal experimentation committee and Head of the Department of Animal Husbandry & Dairying, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, India under the registration number- 20MSAAN005.

Site of the study. The present experiment was carried out in small animal laboratory of the Department of Animal Husbandry & Dairying, SHUATS, Prayagraj, India-211007.

Pre-experimental preparations. Prior to placement of the chicks in the cages, the entire poultry house and its premises were thoroughly cleaned with water and disinfected followed by fumigation with formalin and potassium permanganate (KMnO4 @0.02%). To ensure the maintenance of the bio-safety security of the house, a disinfectant (lime powder) was always provided as a foot dip at the entrance of the house.

Preparation of phytogenic mixture. Good quality Garlic (cloves), Tulsi (leaves) and black cumin (seeds) were purchased from the local market. All three ingredients were procured fresh from the local market. The bulb portion of garlic was peeled followed by slicing into small pieces, fresh Tulsi leaves were washed with clean water and seeds of black cumin seeds were taken together and dried at 40°C for 24 hours in hot air oven. Dried samples were converted to powder using electric grinder and then transferred to separate and labelled air tight vessels and kept in a cool dry place away from sunlight till further usage.

Experimental animals and management. A total of 48 straight run Cobb 400 broiler chicks were purchased from a corporate hatchery firm. Chicks were then administered anti-stress (sugared solution and multivitamins) after their arrival and were distributed according to the treatment groups and identified individually by means of wing tags. Battery type cages were used for rearing birds and they were provided with standard farm managemental practices providing 1.2 sq. ft. /bird space from day-old to four weeks of age. Fresh feed and clean water were served *ad libitum.* Birds were reared under the same environmental conditions. During the brooding, chicks were kept under the maintained temperature at 35° C during the first week, followed by lowering the temperature by 3° C every week till temperature of room was adjusted to 25° C in following days. One bulb of 100 watt was provided in each cage for light and to maintain the temperature in the room. The experimental period was for 28 days from starting week of February 2022 to second week of March 2022.

Experimental design and treatments. The birds were assigned into three comparable treatment groups. Each treatment group had 16 birds comprising 4 replicates in each group with 4 birds per replicate in a complete randomized design. Each group was fed with corresponding experimental diet-

Control: Chicks were provided with standard ration as per NRC (2007) standards, without any supplement.

T_1: Standard ration supplemented with 0.25% of phytogenic mixture per kg of feed.

T_2: Standard ration supplemented with 0.50% of phytogenic mixture per kg of feed.

Phytogenic mixture contained Garlic (*Allium sativum*), Tulsi (*Ocimum sanctum*) and Black Cumin (*Nigella sativa*) powder mixed in equal proportions 1:1:1 and then supplemented in the desired amount in respective treatment groups. The broiler starter diet (Table 1) contained 22% crude protein (CP) with 3, 000 ME kcal/kg whereas, the broiler finisher diet had 20% CP and 3, 150 ME kcal/kg in accordance with NRC standards. The feeding and watering was made available *ad-libitum* to the birds.

Table 1: Ingredient and nutrient composition of experimental diet (%DM).

Ingredients (%)	Broiler starter (0 – 21 day)	Broiler finisher (22 – 28 days)
Corn	53.53	59.58
Soyabean meal (44 %CP)	38.95	33.33
Monodibasic Phosphate	1.44	1.22
Limestone	1.34	1.37
Vegetable oil	3.85	3.53
Salt	0.40	0.41
DL- Methionine	0.208	0.215
L-Lysine- HCL	0.128	0.196
Choline HCL (60%)	0.06	0.05
Mineral- Vitamins premix	0.01	0.01
Total	100	100
Calculated Nutrients		
Crude protein %	22	20
ME, Kcal/kg	3000	3,150
Calcium %	0.91	0.88
Available phosphorus %	0.40	0.36
Sodium %	0.21	0.22
Chloride %	0.26	0.28
Digestible Lys. %	1.17	1.08
Digestible Met. %	0.48	0.49
Digestible Met+ Cys %	0.82	0.78
Digestible Thr, %	0.79	0.73
Choline, mg/kg	1,422	1,312

Parameters studied

Water intake in broilers. Broilers were daily provided with *ad libitum* fresh and clean water in an aluminium vessel whose height was adjusted in accordance with the crop of birds as and when needed. The difference between initial volume of water supplied and final volume of water remaining was calculated daily for actual water intake. The weight of corresponding water volume in water vessel was utilised for final water intake readings after deducting the weight of vessels. The weighing operation was performed with the help of electronic weighing balance with the least count of 0.05g.

Water efficiency in broilers under different groups

Water intake per unit feed intake (FI). WI: FI was calculated by dividing the actual water intake by broilers through the amount of feed consumed by the broilers under different groups.

Water intake per unit body weight (BW). WI: BW was calculated by dividing the actual body weight by broilers through the amount of feed consumed by the broilers under different groups.

Water intake per unit body weight gain (BWG). WI: BW was calculated by dividing the actual body weight gain by broilers through the amount of feed consumed by the broilers under different groups.

Statistical Analysis. All data collected were analysed meticulously for analysis of variance (ANOVA) using Statistical Analysis System software of IBM (SPSS 22). Microsoft Excel was used for statistics and graphical representations. Duncan Multiple Range Test was performed for determining the significant differences among different groups. Difference was considered significant when the value of *P* was lower or equal to 0.05.

RESULTS AND DISCUSSION

Water intake in broilers. Water intake by the broilers in different groups has been presented in Fig. 1 and Table 2. Water intake in broilers of all the groups followed similar pattern. Water intake increased in all the groups with advancements in age of broilers. However, there was significantly no difference (P>0.05) among the groups of broilers under different groups.

Water has role important role in every physiological activity of animals either in direct or indirect way (Jacobs *et al.,* 2020). It has got vital role in digestion, absorption, growth, production, among countless vital roles (Bruno *et al.,* 2011; Orakpoghenor *et al.,* 2021). In overall it supports life and well being of animals. Water intake in broilers may depend upon several factors including water quality, quantity, temperature, type of feeds ingested, type of drinkers, lighting facilities among others (Ibitoye *et al.,*2013; McCreery, 2015; Swiatkiewicz *et al.,* 2017; Jacobs *et al.,*2020; Orakpoghenor *et al.,* 2021). Vieiraand Lima (2005) observed that the feeding of broilers with all vegetable components showed higher (P<0.05) water intake than that in the case of broilers fed with different animal origin ingredients mixed in feed. Marks and Pesti (1984) showed that higher crude protein content in broilers may elevate water intake as compared to lower protein content in broiler feed. Viola *et al.* (2009) suggested that water should be provided to broilers without any kind of restriction to avoid aberrations in normal physiology and performances of broilers. Van Emous *et al.* (2019) investigated that on reducing crude protein content by 15 g/kg in feed did not affect water intake in broiler breeders. Viola *et al.* (2005) found that restriction in water supply resulted in an unusual dinking and feeding behaviours in broilers.

Water efficiency in broilers. Different water efficiency ratios are presented in Fig. 2-4 and overall values are summarized in Table 2. On statistical analysis of data, it was observed that there was significant difference in WI: FI among different groups. Control and T_1 groups had similar values however they differed from T_2. T_2 had lower WI: FI value which shows that water consumed by broilers in T_2 group on per unit feed was less as shown by others groups. This shows that T_2 group broilers utilised water more efficiently for feed intake. Almost all the groups followed similar trend of increasing WI: FI value as the weeks of experiment advanced. This shows that water was needed in comparatively more amounts when feed was utilised by broilers in more amounts for body building and as the age of broilers progressed, their efficiency of water intake for feed consumption enhanced. Hence, T_2 group broilers consumed water efficiently than other groups for utilising the available feed resources.

As shown in Table 2 and Fig. (3 and 4), there was significant difference (P<0.001) among the broilers of different groups for WI: BW and WI: BWG. Highest value was observed in control group followed by T_1 and T_2 group broilers. This suggest that there was improved utilization of water for attaining live body weight and body weight gain in broilers of treatment groups T_1 and T_2. T_1 and T_2 utilised less water for maintenance of body weight and in gain of body weight than that of control group broilers. From the perusal of Fig. 3, it was observed that WI: BW was highest in first week and reduced as weeks progressed. Least value was encountered in fourth week of age. Similar trend was investigated in each group. From close observation of Fig. 4, it was found that there was an increase in WI: BWG value in all groups from first week to fourth week. This shows that the ability of utilisation of water intake for body weight maintenance and gain may be positively influenced by suitable phytogenic mixture supplementation.

Marks (1981) in his study found that increased (P<0.05) water intake per unit feed intake is directly associated with feed conversion efficiencies and lower abdominal fat pad in broilers. Feddes *et al.* (2002) found that higher density of broiler stocking may lead to higher(P<0.05) water intake per unit feed consumption. Marks and Pesti (1984) showed that higher crude protein content in broilers may elevate (P<0.05) water intake per unit feed consumed as compared to that of lower protein content in broiler feed. Jahejo *et al.* (2019) observed that supplementation of basil seed powder @ 5g/kg of feed significantly (P<0.001) reduced water intake in broilers. The reason behind this may be the change in flavour of feed as compared to

non supplemented broilers. Nwezeand Ekwe (2012) also found that supplementation of different levels of basil leaves extract reduced(P<0.05) water intake in broilers.

Table 2: Overall means of water intake indices of broilers in different groups.

Water indices	Control	T1	T2	SEM	Statistical significance
WI (g)	1704.32 [a]	1667.78 [a]	1665.84 [a]	57.25	P=0.076
WI: FI	3.13[a]	3.24 [a]	2.95 [b]	0.05	P<0.001
WI: BW	2.37 [a]	2.26 [b]	2.14 [c]	0.04	P<0.001
WI: BWG	4.72 [a]	4.37 [b]	4.09 [c]	0.08	P<0.001

Means bearing different superscripts differ significantly (P<0.05) in different columns
WI= water intake; WI: FI= water intake per unit feed intake; WI: BW= water intake per unit body weight; WI: BWG= water intake per unit body weight gain

Correlation among different performance and production parameters. Table 3 represents the correlation coefficients among different production parameters of broilers. Pearson's correlation and Spearman's correlation coefficient values are depicted in below and above the diagonal of Table 3. From statistical analysis it was found that there was positive and significant (P<0.05) correlation between WI and blood cholesterol levels. Furthermore, feed intake was found positively and significantly (P<0.05) correlated to body weight, body weight gain, feed conversion ratio. This shows that as the feed intake in broilers increased, body weight, body weight gain and feed conversion ratio was improved. However, feed intake was negatively and significantly (P<0.05) correlated to feed conversion efficiency (FCE). It suggested that more feed intake lowered feed conversion ratio (FCR) in broilers. In addition to this, body weight was negatively and significantly (P<0.01) correlated with cholesterol levels in broilers. This suggested that broilers that had higher body weight tended to have lower cholesterol levels. From perusal of Table 3 it was observed that body weight gain was negatively and significantly (P<0.01) correlated with FCR, abdominal fat and cholesterol levels. Table 3 also shows that FCR had significantly positive correlation (P<0.01) with feed intake, abdominal fat and blood cholesterol levels. Furthermore, FCE had negative and significant (P<0.01) correlation with abdominal fat and cholesterol levels in broilers. This suggested that as FCE enhanced, abdominal fat and cholesterol levels decreased. This means that the birds which showed improved FCE had favourably lower abdominal fat and cholesterol levels. Abdominal fat was found significantly (P<0.01) and negatively correlated with body weight, body weight gain, FCE. However, cholesterol levels and abdominal fat was found significantly (P<0.01) and positively correlated. Cholesterol levels had negative and significant (P<0.01) correlation with body weight, body weight gain, FCE whereas, cholesterol level were significantly (P<0.01) and positively correlated with FCR and abdominal fat in broilers.

Marks (1981) in his study found that increased water intake per unit feed intake is directly associated with feed conversion efficiencies and lower abdominal fat pad in broilers. Feddes *et al.* (2002) found that higher density of broiler stocking may lead to higher water intake per unit feed consumption. Marks and Pesti (1984) showed that higher crude protein content in broilers may elevate water intake per unit feed consumed as compared to that of lower protein content in broiler feed.

Table 3: Pearson's correlation and Spearman's correlation coefficient values below and above diagonal of different performance indices of broilers.

	WI	FI	BW	BWG	FCR	FCE	AbFat	Chol
WI		-0.10	0.01	-0.05	0.01	0.01	0.01	0.24
FI	-0.05		0.36*	0.36*	0.33*	-0.31*	-0.01	0.07
BW	0.01	0.31*		0.96**	-0.70**	0.71**	-0.31*	-0.32*
BWG	-0.04	0.31*	0.97**		-0.69**	0.71**	-0.36*	-0.36
FCR	0.09	0.30*	-0.66**	-0.68**		-0.98**	0.35*	0.44**
FCE	-0.03	-0.31*	0.73**	0.76**	-0.95**		0.35*	-0.39**
AbFat	0.04	0.02	-0.28	-0.38**	0.38**	-0.37**		0.61**
Chol	0.29*	0.07	-0.37**	-0.44**	0.55**	-0.50**	0.49**	

*= values significant (*P*<0.05); *= values significant (*P*<0.01); WI= water intake; FI= feed intake; BW= body weight; BWG= body weight gain; FCR= feed conversion ratio; FCE= feed conversion efficiency; AbFat= abdominal fat; Chol= cholesterol

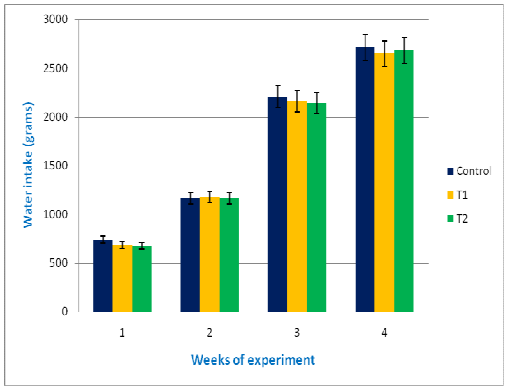

Fig. 1. Water intake in broilers of different groups.

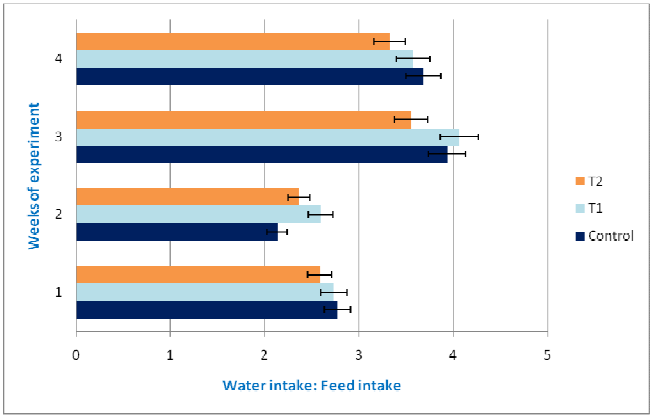

Fig. 2. Water intake per unit feed intake in broilers of different groups.

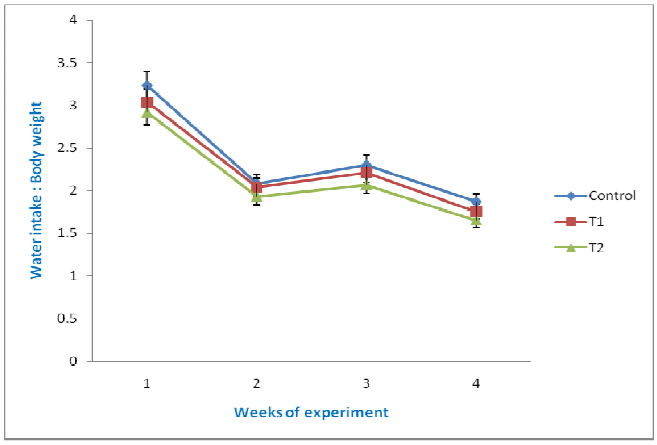

Fig. 3. Water intake per unit body weight in broilers of different groups.

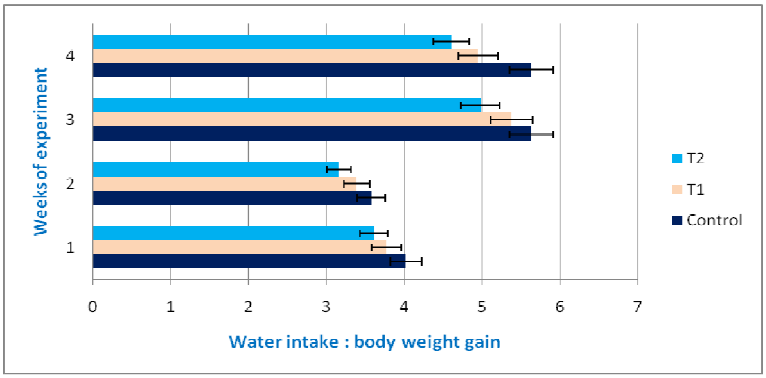

Fig. 4. Water intake per unit body weight gain in broilers of different groups.

CONCLUSIONS

Based on the findings of this study it can be concluded that dietary supplementation of phytogenic mixture @0.25% and 0.50% in feed of broilers did not adversely increased or decreased water intake. However, it was found that phytogenic mixture @0.25% and 0.50% in feed may improve the efficiency of utilization of water in broilers for feed intake, body weight and body weight gain. In our study, there was less number of birds. Hence, we recommend conducting a study which involves more number of broilers in different rearing systems in different climatic regions.

Author's Contribution: PS, N, RP and AKS: conceived the idea; PS: performed the experiment, collected the data; N, RP: guided and assisted in analysis; AKS: drafted, edited the manuscript. All the authors contributed considerably in this study.

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Conflict of Interest. None.

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