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Studying the adding of sheep and cows rumen liquid to drinking water as a probiotic and its effect on productive traits and economic indicator of meat broiler

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ABSTRACT

Current study was conducted in the poultry field of the Department of Animal Production, Faculty of Agriculture, University of Kufa to determine the effect of adding sheep and cows rumen liquids to drinking water as a biological promoter and its effects on productive traits and economic indicator of meat broiler. 240 of one-day-old meat chicks (c.v Ross 308), sex unspecified with initial weight of 45 g were used. Chicks were raised for 35 days in closed hall divided into coops, 3 m^2 in surface area for each and distributed randomly in four treatments with three replicates for each treatment (20 chicks for each replicate). Treatments were as follows: T_1 (control without adding rumen liquid), T_2 (adding 1 mL L^{-1} sheep rumen liquid to drinking water), T_3 (adding 1 mL L^{-1} cow's rumen liquid to drinking water) and T_4 (adding 0.5 mL L^{-1} sheep and cow rumen liquids to drinking water). Chicks were fed with rennet (starter) from the first day for 10 days and fed with grower from the 11^{th} to 24^{th} days then with finisher diet from 25^{th} to 35^{th} days. Results showed that adding sheep and cow rumen liquids together to the diet of broiler was gave the best outcome for the final live body weight, final weight gain, improving feed conversion rate and economic indicator. Most studied traits were not significantly differ when adding cow's rumen liquid to drinking water alone, also all experimental treatments were not significantly differ for the total consumed feed and dressing percentage. Adding the sheep and cow rumen liquids together had positive impact on some productive traits and enhanced the economic indicator of meat broiler.

Keywords: Rumen liquid, Dressing percentage, Biological promoter, Live weight, Economic indicator.
Article type: Research Article.

INTRODUCTION

Beneficial micro-organisms are widely used in animal production fields as a direct addition of food which improve the health and productivity of poultry, reduce their mortality rate and improve feed conversion ratio because of their distinctive properties that not found in antibiotics. Therefore, it was used as appropriate alternative to antibiotics which not accumulate in tissues and had no absorption within the gastrointestinal tract, so it was worthy of a wide area of the interest of researchers in the field of food industries and animal production to increase its immune capability and overcome the obstacles that stand in the way of this important sector (Beigh *et al.* 2017; Van Der Pol 2018; Areaaer *et al.* 2020). The poultry sector faced several problems proven by recent studies, the most important is the nutritional needs of modern chicken breeds which exceeded the needs of old breeds. This led to decreasing in their immunity and their ability to cope with various stresses as well as increased mortality rates. In addition to the lack of important supplies of essential vitamins and minerals, as a result, researchers in poultry nutrition focused on studying non-food additives due to their significant effects in supporting the physiological and productive status of birds including in particular the addition of beneficial microorganisms as a probiotics to improve digestion (Ali *et al.* 2019). Rumen liquid contains massive number of microorganisms such

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as *Lactobacilli* and *Bifidobacter* that can help improving health, immunity and productivity of poultry (Ndams *et al.* 2009). Due to the lack of studies about the use of rumen liquid as a probiotic to feed poultry, the aim of the current study was to determine the effect of adding the sheep and cow rumen liquid to drinking water as a biological promoter and its impacts on productive performance and economic indicator.

MATERIALS AND METHODS

The experiment was conducted in the poultry field of the Department of Animal Production, Faculty of Agriculture, University of Kufa from 30/8/2020 until 4/10/2020. 240 pieces of one-day-old meat chicks (c.v Ross 308), sex unspecified with initial weight of 45 g were employed. Chicks were raised for 35 days in closed hall divided into coops with $3m^2$ for each and distributed randomly on four treatments with three replicates for each treatment (60 chicks for each treatment, 20 chicks for each replicate). Treatments were as follows:

T_1: Control treatment (without adding rumen liquid).

T_2: Adding 1 mL L^{-1} sheep rumen liquid to drinking water.

T_3: Adding 1 mL L^{-1} cow rumen liquid to drinking water.

T_4: Adding 0.5 mL L^{-1} the sheep and cow rumen liquid to drinking water.

Chicks were fed with starter diet from the first day for 10 days and fed with grower from 11^{th} through 24^{th}, then with finisher from 25^{th} through 35^{th}. Rennet were prepared using computer after entering the detailed information about the feed material, its chemical composition and the standard nutritional needs of birds by special feeding program, feed ingredients and chemical formulations are listed in Table 1.

Table 1. Chemical composition and calculated analyses of the starter, grower and finisher diets.

Ingredients	Starter diet (%)	Grower diet (%)	Fisher diet (%)
Ground corn	50.50	54.00	50.50
Soybean meal (48% CP)	36.00	32.00	36.00
Wheat	8.00	8.00	8.00
Premix[1]	2.50	2.50	2.50
Sun flower oil	1.50	2.00	1.50
Dicalcium phosphate	0.1	0.1	0.1
Limestone	1.1	1.1	1.1
Salt	0.3	0.3	0.3
Total	100	100	100
Calculated composition			
Metabolizable energy (Kcal kg^{-1})	3015	3081	3210
Crude protein (%)	23.11	21.51	19.58
Calcium (%)	1.102	1.09	1.08
Avi. Phosphorus (%)	0.74	0.72	0.71
Crude fat (%)	2.3	2.6	3.1
Crude fibre (%)	2.3	2.41	2.45
Lysine (%)	1.12	1.08	1.02
Methionine + cysteine (%)	0.73	0.69	0.65
Energy / protein	130.4	143.2	163.9

Use of Premix Jordanian Origin Type Provimi 3110 Contains: 2750 kcal/ kg Representative energy, 10% raw protein, 1.1% fat, 21% calcium, 11.0% phosphorus, 6.5% methionine, 6.5% methionine + Lysine, 4.8% Sodium, 5.4% Chloride, 575000 IU Vitamin A, 201250 IU Vitamin D_3, 1380 mg Vitamin E, 138 mg Vitamin K_3, 138 mg Vitamin B1, 345 mg Vitamin B, 1840 mg Vitamin B_3, 552 mg Vitamin 5 B, 184 mg B vitamins, 46 mg vitamin B_9, 1000 µg B_{12}, 6900 µg biotin, 14,000 mg choline chloride, 460 mg copper, 2760 mg iron, 3680 mg manganese, 3680 mg zinc, 50 mg iodine, 9.2 mg selenium, 30000 m Vitez mine, 250 mg antioxidants, 250 mg lincomycin, 2400 mg selenomycin.

In this study, live body weight (g per bird), weight gain (g per bird), feed consuming (g per bird), feed conversion ratio and economic indicator were measured.

Statistical analysis

Data of the studied indices were analysed using completely randomized design (CRD) to determine the effect of different treatments. The significant differences between treatments were tested using Duncan (1955), new multiple test at 5% level of significance ($P<0.05$) and the statistical program SAS (2012).

RESULTS AND DISCUSSION

The average weekly live body weight

Live body weight is considered a most important productive trait of broiler, since the appropriate marketing age depends on it and thus reflected on the economic reward of the project which is seeking by all breeders. It is

directly related to the success of broiler breeding projects and main goal for them. Results of Table 2 showed that there were no significant differences between treatments in the live body weight of one-day-old chicks. No significant difference were found on the live body weight in the first week of breeding, when the chicks were fed on the sheep and cow rumen liquid together after adding to drinking water as probiotic. The non-benefit of birds in this age of rumen liquid may be due to the less-developed stomach or the intestinal system compared to adult birds, or due to the small size of gastrointestinal absorption which leads to a short period of feed staying in gastrointestinal tract and then the decreased replication of microorganisms in it. In addition, the microorganisms has not started settlement within the gastrointestinal system, since it takes time to settle and replicate and, so that one week is insufficient to appear the results of birds weights (Esonu *et al.* 2011). After two weeks, the results also indicated no significant differences in the average live body weight in T_2 and T_4 compared to control treatment (T_1) with significant decreasing in T_3 in comparison with other treatments, while T_4 was recorded the highest live body weights (455.16 g). According to the results after three weeks, T_2 exhibited significant elevation ($P < 0.05$) compared to T_1 and T_3, while no significant difference with T_4. The latter achieved a highest average of live body weight (902.67 g) in comparison with T_3 which recorded the lowest average (862.92 g). The outcomes of 4th week indicated that T_2 and T_4 recorded significant ($P < 0.05$) upraised weight, i.e., 1482.42 and 1487.83 g respectively exceeding T_1 and T_3 significantly, while T_3 recorded the lowest average of live body weight (1365.75 g), however, not significantly differ from T_1 (1388.83 g). The statistical analyses (shown in Table 2) displayed that the results of 5th week were similar to those of 4th week, since there was a significant elevation in the birds weight in T_2 and T_4 compared to T_1 and T_3. T_4 exhibited the highest average of live body weight (1970.97 g; $p < 0.05$), exceeding T_1 and T_3 with no significant difference. T_2 achieved 1940.92 g, while the lowest average was recorded in T_3 (1824.25 g) compared to control treatment (1848.50 g). Moral superiority in the live body weight of T2 and T4 may be attributed to the role of microorganisms in the sheep rumen liquid which may contains more species than those in cow rumen liquid, due to the different feeding type of these animals. Naji *et al.* (2011) pointed out that microorganisms in the probiotic work on exclusion of harmful microorganisms and settlement of beneficial ones in gastrointestinal tract through the mechanism of competitive exclusion. On the other hand, Glade & Fist (1988) stated that the productive improving of broiler chickens by adding rumen liquid may related to the ability of microorganisms to produce many enzymes that contribute to accelerating digestion process which reflected positively on increasing the weight. The significant increasing of live body weight may also attributed to the beneficial microorganisms activities in rumen liquid which work on reducing the pathogenic bacterial colonies and diminishing metabolic toxins, hence improving digestion. They also play a role in providing nutritional elements which leads to increased weight. Moreover, microorganisms have the ability to activate the raw fibre inside bird intestine and to increase the occurrence of peristaltic movements and the production of enzymes which leads to an increased digestion of nutrients more efficiently (Esonu *et al.* 2011). The rumen liquid contains large group of microorganisms (bacteria, fungi, protozoa and yeasts) capable of producing enzymes which can digest and break down proteins, non-nitrogenous compounds, cellulose and phenolic polymers due to their ability to synthesize ß-Glucanases, while mono-gastric animals such as birds are unable to decompose and digest these compounds (Taoma, 2014). The prevalence of beneficial bacteria in the bird gastrointestinal tract provided by the rumen fluid leads to an elevated efficiency of digestion and absorption by upraising the villi length and thus increasing the surface area of absorption as well as their role in improving the health status by enhancing the immune response (Abdulwahid 2017).

Table 2. The effect of adding rumen liquid of sheep and cows to drinking water as probiotic and its effect on the average live body weight (g) of broiler for the experimental weeks.

	Mean weight (g) ± standard error					
Treatments	One-day-old	1st week	2nd week	3rd week	4th week	5th week
T_1	45.25 ± 0.14	168.00 ± 2.25	453.41^{a} ± 3.30	882.41b ± 2.86	1388.83^{b} ± 4.55	1848.50^{b} ± 5.65
T_2	45.58 ± 0.10	171.91 ± 6.41	454.16^{a} ± 3.47	902.67^{a} ± 8.82	1482.42^{a} ± 47.80	1940.92^{a} ± 10.29
T_3	45.33 ± 0.08	163.33 ± 1.12	434.25^{b} ± 8.45	862.92^{c} ± 3.46	1365.75^{b} ± 12.92	1824.25^{b} ± 32.30
T_4	45.08 ± 0.13	169.41 ± 1.44	455.16^{a} ± 1.74	899.25^{ab} ± 5.89	1487.83^{a} ± 10.40	1970.97^{a} ± 8.75
Sig. level	NS	NS	*	*	*	*

Note: Different letters within same columns means that there were significant differences at $p < 0.05$; NS: no significant differences between means.

The average weight gain (g)

Weight gain trait is considered as an indicator of the average of broiler bird growth and its speed, for this reason, breeders of poultry are interested in improving this trait as they can within less time as possible of breeding.

Results of Table 3 showed that there were no significant effects for weeks 1, 2, 3 and 5 of chick's age. While, in week 4, the T_4 was recorded significant increasing of weight gain at $P < 0.5$ and exceeded all other treatments except T_2 which has no difference between them as T_4 recorded the highest average of weight gain 588.58g/bird, while, T_3 recorded the lowest average weight gain (502.83 g). The total increasing of weight gain was recorded significant increasing in T_2 and T_4 compare to T_3 and control treatment (T_1) as T_2 gave the highest average weight gain (1895.33 g) in comparison with the lowest average (1778.92 g) in T_3, and 1803.25 g in T_1.

Results are clearly indicated that the adding rumen liquid to drinking water was achieved positive increasing in the total weekly weight gain forward the significance which particularly occurred when adding sheep rumen liquid and it mixture with cows rumen liquid, this difference between the two liquids may because of the difference microorganisms types and its amount which are differed depending on animal and feeding types. This may explain the action of beneficial microorganisms contained in the rumen liquid and its diversity which provides the opportunity to secrete many useful products that help the bird increase the digestive factor in addition to its role as a vital competitor to harmful organisms within the gastrointestinal tract (Mohammed *et al.* 2016). Jin *et al.* (2002) pointed out the reason for the significant increase in this trait to the role of microorganisms in increasing the readiness of nutrients inside the gastrointestinal tract and their production of many important nutrients such as dissolved vitamins in water especially B complex vitamins. In addition, sheep rumen liquid contain huge amount of beneficial microorganisms particularly the bacteria which estimated about 4.08 in each ml of sheep rumen liquid (Mahdi 2020) and help to increase digestion and absorption processes as a result of producing many enzymes which degrades the components of feed provided to the bird (Naji *et al.* 2009) and this may be due to the ability of the various rumen microorganisms to form essential amino acids which is positively reflected in the interest of the bird weight gain (Gonzales *et al.* 2014). The moral response may also be due to what microorganisms do in feeding poultry by creating and maintaining microbial balance and changing the level of metabolism processes that take place by increasing the effectiveness of digestive enzymes, improving the rate of food intake, digestion and the production of ammonia (Manhob *et al.* 2016). In addition, the ability of these organisms to stimulate the intestinal mucosa of the bird and increase protection against toxins produced by pathogens (Odefemi 2016).

Table 3. The effect of adding rumen liquid of sheep and cows to drinking water as probiotic and its effect on the average weight gain (g) of broiler for the experiment weeks.

	Mean (g) ± standard error					
Treatments	1st week	2nd week	3rd week	4th week	5th week	Total weight gain
T_1	122.75 ± 2.22	285.41 ± 3.44	429.00 ± 0.52	505.75^{b} ± 7.32	460.33 ± 1.66	1803.25b ± 5.64
T_2	126.33 ± 6.40	282.25 ± 5.92	448.50 ± 8.32	579.75^{ab} ± 43.57	458.50 ± 54.15	1895.33a ± 10.30
T_3	118.00 ± 1.13	270.91 ± 8.76	428.67 ± 7.04	502.83^{b} ± 11.33	458.50 ± 20.93	1778.92b ± 32.31
T_4	124.33 ± 1.44	285.75 ± 3.01	444.08 ± 4.14	588.58^{a} ± 15.57	483.13 ± 15.36	1925.88a ± 8.77
Sig. at p< 0.05	NS	NS	NS	*	NS	*

Note: Different letters within same column means there were significant differences at $P < 0.05$; NS: means no significant differences between means.

Feed consumption

Table 4 results showed a presence of significant discrepancy in the amount of feed consumption when chicks become bigger. Statistical results showed that there were no significant differences at $P \leq 0.5$ for weeks 1, 2, 3, and 4 in total feed consumption in all treatments compare to control treatment. While, adding rumen liquid to drinking water made significant differences between treatments when chicks became 5 weeks old.

Table 4. The effect of adding rumen liquid of sheep and cows to drinking water as probiotic and its effect on the average feed consumption (g) of broiler for the experimental weeks.

	Mean (g) ± standard error					
Treatments	1st week	2nd week	3rd week	4th week	5th week	Total weight gain
T_1	130.00 ± 5.77	391.33ab ± 8.73	657.58 ± 4.74	821.75 ± 19.93	1027.25a ± 24.88	3027.92 ± 15.37
T_2	136.00 ± 1.5	420.42a ± 14.51	678.25 ± 14.25	850.00 ± 18.19	989.17ab ± 4.71	3073.83 ± 38.17
T_3	135.16 ± 7.01	365.08b ± 20.08	678.58 ± 14.63	840.17 ± 31.38	957.25b ± 25.56	2976.25 ± 70.91
T_4	144.83 ± 9.68	370.75b ± 2.67	688.50 ± 23.23	847.08 ± 27.23	978.42ab ± 13.86	3029.58 ± 53.74
Sig. at p < 0.05	NS	*	N.S	N.S	*	N.S

Note: Different letters within same column means there were significant differences at $p < 0.05$; NS: No significant differences between means.

The significant reducing in the average feed consumption when adding different levels of rumen liquid to drinking water may occur due to the improved providing nutrients as a result of elevated digestion percentage after secretion of digestive enzymes by microorganisms (Al-Qaysi *et al.* 2006). In addition, when birds consumed to get their

needs of energy, it reached the perfect level of energy quickly (Onu *et al.* 2011). These results are proven that adding rumen liquid to the drinking water had no negative effect on the weekly average of feed consumption in general.

Feed conversion ratio

This trait is depending directly on the average feed consumption and weight gain of bird, and the benefits of any productive project can be determined by this index, reflecting the extent of advantage from feed provided to the bird during breeding period. Results of Table 5 showed no significant effect at $p < 0.5$ for weeks 1, 2, 3, 4 and 5 compared to control, likewise, T_1, T_3 and T_4 exhibited no differences between each other. T_4 recorded significant improvement in feed conversion ratio in comparison with T_1 and T_3, while not significantly differed from T_1, T_2 and T_3. All experimental treatments were improved significantly compared to control group. The reason for the significant improvement of feed conversion ratio was explained by Falaki *et al.* (2011) who reported that the adding probiotic helped the beneficial microorganisms to grow and replicate in gastrointestinal tract which reflected positively in improving digestion, absorption and metabolic processes. Mohammed Redha 2012, suggested that probiotic is contributed in the readiness of many nutrients including mineral elements, fats, carbohydrates, proteins and vitamins. Also, microorganisms can provide an appropriate media for enzymes and thus improve digestion process, by secreting useful materials by digesting nutrients into small units and make it easy to absorb, which is reflected on improving feed conversion ratio (Kopecky *et al.* 2012). Abdulwahid (2017) suggested that this significant improvement in feed conversion ratio is due to the role of microorganisms in stimulating host to form complex B vitamin groups as well as providing enzymes to digest and increase the production of aromatic fatty acids, which works to improve the efficiency of this ratio. Moreover, Hammod *et al.* (2018) pointed out that the significant improvement of feed conversion ratio may attribute to the improvement of bird status as a result of microorganisms activities in the rumen liquid and preventing the activity of harmful pathogens.

Table 5. The effect of adding rumen liquid of sheep and cows to drinking water as probiotic and its effect on feed conversion ratio (kg feed / kg weight gain) of broiler for the experiment weeks.

	Mean FCR (kg feed / kg weight gain) ± standard error					
Treatments	1st week	2nd week	3rd week	4th week	5th week	Total FCR
T_1	1.06 ± 0.03	1.37^{ab} ± 0.02	1.53 ± 0.00	1.62 ± 0.01	2.23 ± 0.05	1.68^{a} ± 0.01
T_2	1.08 ± 0.06	1.49^{a} ± 0.01	1.51 ± 0.04	1.48 ± 0.09	2.21 ± 0.22	1.62^{ab} ± 0.02
T_3	1.14 ± 0.06	1.35^{ab} ± 0.07	1.58 ± 0.06	1.67 ± 0.03	2.09 ± 0.08	1.67^{a} ± 0.02
T_4	1.16 ± 0.06	1.30^{b} ± 0.00	1.55 ± 0.04	1.44 ± 0.06	2.03 ± 0.04	1.57b ± 0.02
Significant level at $p < 0.05$	NS	*	NS	NS	NS	*

Note: Different letters within same column means there were significant differences at $p < 0.05$; NS: No significant differences between means.

Dressing percentage, economic indicator and mortality

Statistical analysis results showed no significant differences in dressing percentage in all treatments compared to control group despite of recording the highest dressing percentage (73.20%) in T_2 in comparison with 71.79% in T_4 (Table 6).

Table 6. The effect of adding rumen liquid of sheep and cow to drinking water as probiotic and its effect on dressing percentage and economic indices.

Treatments	**Mean ± standard error**	
	Dressing percentage (%)	Economic indicator
T_1	72.39 ± 0.79	316.40 b ± 7.40
T_2	73.20 ± 0.26	341.87 ab ± 12.80
T_3	72.16 ± 0.91	312.17 b ± 6.71
T_4	71.79 ± 0.92	355.73 a ± 12.34
Significance level at $p < 0.05$	NS	*

Note: Different letters within same column means there were significant differences at $p < 0.05$; NS: No significant differences between means.

Economic indicator is considered as an important index representing the efficiency of breeding, the quality of production and the success of field management of the project, since it depends on the mean of live body weight in marketing and feed conversion ratio. Table 6 depicts that there were significant differences ($p < 0.05$) in the economic indicator of the treatments, so that, T_4 exceeded T_3 and control group with the highest average (355.73) which not significantly differ from T_2 (341.87), while T_3 recorded the lowest average (312.17), not significantly differ from T_2 as well. This significant achievement in the economic indicator is a result of increased live body

weight, enhancing feed conversion ratio without mortality. Hence elevating economic indicator which refers to the potential of using rumen liquid in broiler feeding to improve economic rewards of the private projects of farmers. In addition, it improves the efficiency of production of most treatments which represented by total weight and feed conversion ratio also reasons of this significant increasing. Incorporating rumen liquid in broiler diet reduces the consuming of feed and increase at the same time body weight and feed conversion which effects positively in reducing production cost (Onu *et al.* 2011). The contents of rumen liquid are clearly affect enhancing productive performance and economic indicator (Al-Mashhadani & Taoma 2014). Mortality was not recorded for the 35 days of the experiment and this confirm that the rumen liquid has no pathogenic effects on chick's health.

CONCLUSION

Adding the rumen liquid of sheep and cow as a probiotic to drinking water during chicks breeding enhanced live body weight, feed conversion ratio, dressing percentage and economic indicator in broiler chicks. It can be recommended in breeding projects, since it decrease the mortality in poultry fields as well as prevent pathogenic microorganisms, reflecting directly on chick's health. In general, the sheep and cow rumen liquid together exhibited positive impact on productive traits of meat broiler which means successful management for poultry fields.

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