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Effect of Probiotics and Acidifiers on Carcass Yield, Internal Organs, Cuts and Meat to Bone Ratio of Broiler Chicken

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Abstract: *The aim of the present study was to investigate the effect of probiotic, Acidifiers and their combination on carcass characteristics, internal organs, cuts performance and meat to bone ratio in broilers chicks. Two hundred and twenty, one day old unsexed broiler chicks (Ross308 strain) was used in this study. They were divided into four groups with five replicates (11 chicks per each). Group A fed the basal diet (control), group B fed the basal diet supplemented with probiotic (Bacillus subtilis) powder (1.6X 10^9 CFU/gm) at inclusion rate of 500gm/tone. Group C fed the basal diet supplemented with acidifiers; organic acids (Citric Acid, Fumaric Acid, D-L Malic Acid, Lactic Acid and Ortho-phosphoric Acid) at an inclusion ratefade 2kg/tone feed. Group D fed the basal diet supplemented with combination of Bacillus subtilis plus organic acids with the same inclusion rate as in groups (B) and (C) treatments. The addition of bacillussubtilis, acidifiers and their combination did not show any significant ($P > 0.05$) effect in regard to live body weight, net carcass, dressing percentage and the relative weight of internal organs.The bacillus subtilis supplemented group showed the highest breast weight with a significant ($P < 0.05$) difference as compared to acidifiers supplemented group. In addition, the inclusion of probiotic significantly affect the ratio of bone in the back bone cut and significantly ($P < 0.05$) increased skin ratio of breast cut.*

Keywords: *Broilers, Bacillus, Carcass traits. growth promoters*

I. Introduction

High levels of production and efficient feed conversion are increase the need of the modern broiler industry which to a certain extent could be achieved by the use of specific feed additives. Author [1] noticed that there has been an increased in nutrient metabolism in broilers supplemented with organic acida.A researcher [2] concluded that using growth – promoters lead to observed increase in humoral immunity and significant improvement in production factors.It is also reported that the addition of prebiotics and acidifiers improved growth performance, carcass characteristics and decreased serum cholesterol level of the broiler chickens [3] Another worker [4] found that probiotics such as Biotronics SE as suitable growth promoters when replacing antibiotic growth promoters.

The useof antibiotics as growth promoters led to increase of antibiotic resistant strains of bacteria which compelled the researchers to find other non-therapeutic alternatives of low costs. These include organic acids, enzymes, probiotics and prebiotics, as feed additives in poultry production [5] .Since the importance of well-balanced gut micro flora for adequate health and high performance has been recognized; feeding strategies have been directed to control the microbial gastrointestinal environment. One key strategy is to feed directly the microorganisms which are supposed to exert a beneficial effecton the gut. [6] .Probiotics are identified as live microorganisms which can be supplemented to the feed in order to establish a beneficial gut micro flora [7] .Thus, probiotics have the potential to beneficially affect gut health by modification of the gut microflora, especially in young animals, in which a stable gut micro flora are not yet established[6] .The growth performance can improve when birds fed diets supplemented with *Bacillus subtilis* which secrete protease, amylase, and lipase [8.As alternatives to antibiotic poultry producer can be used the organic acids which constitute an important component of modern feeding practices due to their growth promoting properties [9].Therefore the purpose of this study was to determine the influence of probiotic, acidifiers and their combination on carcass characteristics, internal organs, cuts performance and meat to bone ratio in broilers chicks.

II. Materials And Methods

Experimental Birds: The experiment was carried out in the premise of Poultry Research Unit, Department of Poultry Production, Faculty of Animal Production University of Khartoum, (Khartoum North, Sudan). The experiment was held during the period between February 9th – 23 th March 2014. The laboratory analyses were carried out at the Department of Meat Production, Faculty of Animal Production, University of Khartoum.

Two hundred and twenty, one-day-old unsexed broiler chicks (Ross308 strain) were purchased from the local commercial company during the winter season. The chicks were divided into four groups, with five replicates (11 chicks per each). Birds were raised under deep litter system of the same management condition. Continuouslighting was provided throughout the entire duration of the experiment. Feed and water were provided *ad-libtum*. Vaccination was strictly adhered to as recommended for broiler chicks in the tropical environment.

Experimental diets: The experimental diets were formulated from local ingredients except for the imported super concentrate. The birds were allowed to have free access to feed and water during the rearing period, which was divided into two phases; starter (1-21day), finishing (22-42day) in which birds fed on starter and finisher diets respectively. Group A fed the basal diet (control), group B fed the basal diet supplemented with commercial probioticincluding *Bacillus subtilis* powder (1.6X 10^9 CFU/gm) at inclusion rate of 500gm/tone. Group C fed the basal diet supplemented with commercial acidifiers; organic acids (Citric Acid, Fumaric Acid, D-L Malic Acid, Lactic Acid and Ortho-phosphoric Acid) at inclusion rate of 2/kg/tone feed. Group D fed the basal diet supplemented with combination of *Bacillus subtilis* plus organic acids with the same inclusion rate as in groups (B) and (C) treatments. The formulation and calculation of the experimental diets (starter and finisher) were shown in Tables (1, 2 and 3). The feed was formulated according to the guidelines provided by [10] .

***Data Collection*:** The reported minimum and maximum temperature and relative humidity were recorded throughout the experimental period to be (17.2°C- 36.8°C and 15.2%, 43.3%). At the end of the experiment (day 42), the birds were fasted overnight except for water. Two birds from each replicate were randomly selected then leg banded and individually weighed. Birds were then manually slaughtered without stunning, scalded, feather manually plucked and washed. Afterwards, the head was removed and feet as well as shanks were dissociated at the hock joints. Evisceration was accomplished by ventral cuts for complete removal of vescera then weighing of the internal organs namely liver, heart, gizzard, spleen, and abdominal fat. One side of the carcass was cut into; thigh, breast, back bone, drumstick, and wing and weighed. The cuts were de-boned and the meat, bone, and skin were separated and weighed then the values of the meat, bone and skin ratio were calculated.

***Statistical Analysis*:** Data obtained were subjected to analysis of variance based on completely randomized design arrangement by general linear model using (Statistix program, version 8). Means separation were done by LSD multiple range tests and the values were expressed as means and standard error.

III. Results And Discussion

***Live body weight and carcass characteristics*:** The effect of supplementation of probiotic, acidifiers and their combination on broiler live body weight, net carcass, and dressing percentage was illustrated in Table (4). The results did not show any significant ($P > 0.05$)differences between control and other treated groups. This result is in agreement with [11,12,13]who noted no any significant effect on broiler performance and carcass yield in response to probiotic supplementation. These results are in agreement with those of [5] who reported that the carcass characteristics of broiler chicken fed diets supplemented with organic acids showed no significant ($P > 0.05$) differences between various treatments. Nevertheless, [14] and [15] found that probiotic increases significantly ($P < 0.01$) carcass yield in both vaccinated and non-vaccinated broiler chicks. Furthermore,[16] found that the mean values of hot dress weight, cold dress weight, and dressing percentage were significantly ($P < 0.05$)higher in broilers fed probiotic.

***Internal Organs*:** Relative weight of internal organs (liver, gizzard, heart, spleen, intestine, and abdominal fat) of broilers treated groups was presented in Table (5).The results demonstrated no significant ($P > 0.05$) difference among the different experimental groups. This indicated that the inclusion of probiotic, Acidifiers and their combination had no effect on the weight of the internal organs. This result is in agreement with [8] who found that the edible inner organs liver and abdominal fat were not affected by probiotic supplementation. However, [16] reported that the mean values of giblets are significantly higher in probiotic fed broilers. The addition of acidifiers did not affect the intestine weight, this is in contrast to what have been reported by [17] and [5] ,who illustrated that chicks fed diets supplemented with organic acids showed significant increase in the length and weight of small intestines when compared to control group. This might attributed to the fact that organic acid have direct stimulatory effect on gastrointestinal cell proliferation..

The weight of broiler cuts: Relative weight of broiler cuts (breast, thigh, drum stick, back bone and wing) shown in Table (6). The results demonstrated significant ($P < 0.05$) difference in breast weight among experimental groups. Birds fed probiotic supplemented diet showed significantly ($P < 0.05$) heavier breast versus those fed diet supplemented with acidifiers. However, birds fed the control diet showed no significant ($P > 0.05$) difference when compared with other dietary treatment. Breast is the one of the most important economic primal cut in the chickens; the increasing in this cut might due to great retention of nutrients caused by probiotic. This result in contrast to [8] .who noted that the probiotic supplemented group has a greater breast percentage compared with the control group. Where the weight of other broiler cuts (thigh, drum stick, back bone and wing) were not affected by supplementation of probiotic, acidifiers, and their combination.

Meat Ratio of the Cuts:The effect of probiotic, acidifiers and their combination on meat ratio of de-boned cuts was shown in Table (7). It was clear that the addition of probiotic numerically increased the ratio of meat in breast cut the most important economic cuts, and resulted in a numerically higher value of meat ratio in back bone compared to other groups, this result might due to better retention of nutrients due to probiotic supplementation and affect on consumer preferences. The addition of probiotic improves the retention of nitrogen, calcium, and phosphorus [18] . The ratio of meat in de-boned cuts (thigh, drum and wing) was not affected by various treatments.

Bone Ratio of the Cuts:The bone ratio in de-boned cuts (breast, thigh, drum stick, back bone and wing) for treatment groups was shown in Table (8). The results demonstrated that there was a significant ($P < 0.05$) difference in the bone ratio of the back bone in birds fed diet supplemented with probiotic which proved to achieve significantly ($P < 0.05$) higher bone ratio of the back bone cut versus groups other than control. This result might be due to the enhancement of mineral retention due to addition of probiotic. The results reflected that the ratio of bone in cuts (breast, thigh, drum stick and wing) were not affected by inclusion of probiotic, acidifiers and their combination.

Skin Ratio of the Cuts:Table (9) shows the effect of probiotic, acidifiers and their combination on skin ratio. The results demonstrated that the addition of probiotic significantly ($P < 0.05$) increased the ratio of skin in the breast when compared with groups other than control and the addition of acidifiers numerically increased the ratio of skin in the back bone and the addition of combination of probiotic and acidifiers numerically increased the ratio of skin in the drum stick.These results might be due to the effect of probiotic, acidifiers and their combination on fat deposition in the various cuts

IV. Conclusions

It could be concluded that there was no significant effect of the addition of Probiotic, Acidifiers and their combination on Live body weight, carcass weight, dressing percentage and the relative weight of internal organs. Broilers supplemented with probiotic obtained higher value of breast weight while the other cuts were not affected by treatments. Moreover the various treatments not affected on weight of meat to bone ratio when the cuts were de-boned except that the addition of probiotic resulted in higher bone ratio of back cut and higher skin ratio of the breast cut.

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Table 1: Composition and calculated analysis of broiler Starter diet

Ingredients	Experimental rations			
	A	**B**	**C**	**D**
Sorghum	67.53	67.50	67.45	67.45
Groungnut cake	24.84	24.85	24.85	24.84
Super concentrate*	5.00	5.00	5.00	5.00
Lysine	0.20	0.20	0.20	0.20
Methionine	0.15	0.15	0.15	0.15
Dicalcium phosphate	0.50	0.50	0.50	0.50
Limestone	1.03	1.00	0.95	0.95
Nacl	0.20	0.20	0.15	0.15
Choline chloride	0.10	0.10	0.10	0.10
Premix**	0.25	0.25	0.25	0.25
Antimycotoxins	0.20	0.20	0.20	0.20
Bacillus subtilis	0.00	0.05	0.00	0.05
Organic acids	0.00	0.00	0.20	0.20
Calculated analysis				
Crude protein	23.24	23.24	23.23	23.21
Crude fiber	3.90	3.90	3.90	3.90
Crude fat	3.53	3.53	3.53	3.53
Lysine	1.26	1.26	1.26	1.26
Methionine	0.51	0.51	0.51	0.51
Calcium	1.04	1.03	1.01	1.01
Available phosphorus	0.41	0.41	0.41	0.41
ME (Kcal/kg)	13.20	13.20	13.20	13.20

*Super concentrate analysis per Kg: ME 8.79 MJ/Kg, CP 36%, CF 5%, EE, 2.5%, Lysine 11%, Methionine CA5%, Ca 6-8%, TP 2%, AP 4.2%

**Vitamins and minerals within premix per Kg: Vitamin A 800.000 IU, Vitamin D3 720.000 IU, Vitamin E 4.100 mg, Vitamin K3 300 mg, Vitamin B1 500, Vitamin B2 1.180 mg, Vitamin B6 510 mg, Vitamin B12 1.800 mg, Niacin 4.400 mg, Folic acid 76 mg, Choline chloride 57.800 mg, Iron 5.700 mg, Zinc 16.200 mg, Copper 4.500 mg, Manganese 16.200 mg, Iodine 540 mg, Selenium 80 mg, Calcium 250 g, Magnesium 11.610 mg.

Table 2: Composition and calculated analysis of broiler finisher diet

Ingredients	Experimental rations			
	A	**B**	**C**	**D**
Sorghum	66.90	66.90	67.03	67.48
Groundnut cake	15.40	15.40	15.47	15.70
Wheat bran	8.54	8.50	8.20	7.46
Super concentrate	5.00	5.00	5.00	5.00
Vegetable oil	2.00	2.00	2.00	2.00
Lysin	0.11	0.11	0.11	0.11
Methionin	0.10	0.10	0.10	0.10
Dicalciumphoshate	0.50	0.50	0.50	0.50
Limestone	0.80	0.80	0.80	0.80
Nacl	0.20	0.20	0.15	0.15
Choline chloride	0.10	0.09	0.09	0.10
Premix	0.25	0.25	0.25	0.25
Antimycotoxins	0.10	0.10	0.10	0.10
Bacillus subtilis	0.00	0.05	0.00	0.05
Organic acids	0.00	0.00	0.20	0.20
Calculated analysis				
Crude protein	20.00	20.00	20.00	20.00
Crude fibres	4.20	4. 19	4.16	4.42
Crude fat	3.11	3.11	3.11	3.38
Lysine	1.10	1.10	1.10	1.10
Methionin	0.44	0.44	0.44	0.44
Calcium	0.91	0.91	0.91	0.91
Available phosphorus	0.42	0.42	0.42	0.41
ME (MJ/kg)	13.39	13.39	13.39	13.39

Table 3: Chemical composition of the experimental diets

Treatment	Starter				
	Crude Protein	Crude fiber	Crude fat	Ash	Moisture
A	24.92	4.12	2.99	5.85	5.27
B	24.27	3.66	3.18	6.17	6.01
C	23.60	3.60	3.16	5.98	6.16
D	23.11	3.57	3.20	5.95	5.74
	Finisher				
A	20.85	3.68	4.35	5.90	6.43
B	20.67	3.94	4.15	5.50	6.25
C	21.22	3.89	4.30	6.16	6.04
D	20.40	3.69	4.28	5.73	6.19

Table4: Effect of Probiotic, acidifiers and their combination on carcass characteristics and dressing percentage of broilers.

Parameters	Treatments				±SEM
	Control	Probiotic	Acidifiers	Combination	
Live Weight (g)	1823.0 ^{a}	1870.5	1721.5	1876.5 ^{a}	124.63
Net Carcass (g)	1189.3 ^{a}	1222.6	1115.8	1223.8 ^{a}	88.603
Dressing %	65.10	65.07	65.82	65.18	1.2822

Values are means of 10 birds per replicate.
Means within the same row with different superscripts differ significantly at (P < 0.05).
SEM: Standard error of means.

Table 5: Effect of probiotic, acidifiers and their combination on relative weights of internal organs of Broilers

Parameters	Treatments				±SEM
	Control	Probiotic	Acidifiers	Combination	
Liver (%)	2.08	2.31	2.20	2.06	0.11
Gizzard (%)	2.44	2.56	2.37	2.49	0.10
Heart (%)	0.42	0.53	0.45	0.43	0.03
Spleen (%)	0.099	0.120	0.330	0.113	0.05
Intestine (%)	5.14	5.32	5.42	5.22	0.26
Abdominal fat (%)	1.12	1.07	1.11	1.32	0.12

Values are means of 10 birds per replicate.
Means within the same row with different superscripts differ significantly at (P < 0.05).
SEM**:** Standard error of means

Table 6: Effect of Probiotic, Acidifiers and their combination on weight of broiler cuts

Parameters	Treatments				±SEM
	Control	Probiotic	Acidifiers	Combination	
Breast weight (g)	198.09^{ab}	213.02^{a}	178.95^{b}	199.56^{ab}	15.23
Thigh weight (g)	102.09	97.17	99.04	109.19	9.30
Drum weight (g)	86.37	89.82	149.53	96.36	48.479
Back bone weight (g)	136.86	138.50	129.67	123.96	12.26
Wing weight (g)	74.24	72.49	67.76	72.43	4.64

Values are means of 10 birds per replicate.
Means within the same row with different superscripts differ significantly at (P < 0.05).
SEM: Standard error of means.

Table 7: Effect of Probiotic, Acidifiers and their combination on meat ratio of the cuts.

Parameters	Treatments				±SEM
	Control	Probiotic	Acidifiers	Combination	
Breast meat ratio	139.30	139.70	109.70	129.20	14.96
Thigh meat ratio	104.20	91.14	87.18	93.08	11.92
Drum meat ratio	52.30	52.00	44.20	50.30	6.62
Back meat ratio	40.90	47.00	43.12	37.20	6.01
Wing meat ratio	26.40	26.10	22.10	25.20	3.23

Values are means of 5 birds per replicate.
Means within the same row with different superscripts differ significantly at (P < 0.05).
SEM: Standard error of means.

Table 8: Effect of Probiotic, Acidifiers and their combination on bone ratio of the cuts.

	Treatments				
Parameters	Control	Probiotic	Acidifiers	Combination	±SEM
Breast bone ratio	27.90	26.50	18.90	24.90	5.96
Thigh bone ratio	68.80	59.50	61.50	62.60	9.93
Drum bone ratio	20.00	20.70	16.00	19.60	2.76
Back bone ratio	55.70^{ab}	66.10^{a}	44.60^{bc}	34.20^{c}	9.59
Wing bone ratio	25.90	26.30	21.30	23.80	2.56

Values are means of 5 birds per replicate.
Means within the same row with different superscripts differ significantly at ($P < 0.05$).
SEM: Standard error of means.

Table 9: Effect of Probiotic, Acidifiers and their combination on Skin Ratio of the cuts.

	Treatments				±SEM
Parameters	Control	Probiotic	Acidifiers	Combination	
Breast skin	24.00^{ab}	25.70^{a}	15.9^{b}	24.80^{a}	4.74
Thigh skin	12.80	11.30	11.60	11.70	3.20
Drum skin	8.30	11.60	7.00	12.20	2.50
Back skin	19.10	24.40	26.80	22.80	5.36
Wing skin	13.40	15.80	12.20	12.30	1.85

Values are means of 5 birds per replicate.
Means within the same row with different superscripts differ significantly at ($P < 0.05$).
SEM: Standard error of means.