Broiler Performance to the Addition of Local Pearl Millet Soaked in Citric Acid to the Diet

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Abstract:
This study was carried out to determine the influence of replacing different levels of millet grains instead of corn on the performance of broiler chickens. A total of 300-day-old broiler chicks (Ross 308) were randomly distributed into five groups contains three replicates (20 birds/pen). Each group was fed on the one of the following experimental diets. Diet 1 was the control: 100% corn, Diet 2: 100% normal millet, Diet 3: 100% soaked millet in citric acid, Diet 4: 50% corn+50% normal millet, Diet 5: 50%corn+50% soaked millet in citric acid. All diets were iso nitrogenous and metabolisable energy during starting and finishing phases. Results showed that there were significant differences (P≤0.05) between all treatments, i.e. weight gains and feed consumption, and feed conversion ratio in all periods, also it was noticed significant differences in carcass traits, i.e. dressing percentage, and carcass cuts recorded in birds which apprehension diets contained normal and soaked millet in citric acid. Pearl millet grains have been given the best performance and carcass traits than corn grains in broilers diets.

Key Words: Soaked millet, Growth performance, Carcass traits, Pearl millet, Citric acid.

Introduction:

The need to a source, harness, process and utilize alternative feed stuff otherwise known as unconventional feed ingredients in the diets of poultry birds is more critical now than ever. This is because feed cost accounts for over seventy percent of the cost of producing edible meat and eggs (Aduku, 2004). The rising cost of poultry feeds have continued to be a major problem in developing countries as feed cost is about 60 to 70% (Conolly, 2012) compared to about 50 to 60% in developed countries.

Millet growing is widely spread in Dhi Qar Governorate south of Iraq. The quantities of millet produced for the years 2016, 2017, 2018, 2019 and 2020 are in the range of 3740, 3670, 4741, 5110 and 4458 tons, respectively, while the yield of a dunum is an average of 400 kg/Tons. Note that the cost per ton is 266-dollar USA/ton compromised with imported corn 433-dollar USA/ton (Iraq Agriculture Ministry, 2020). Therefore, the aim of the current study was to solve part of the problem facing poultry breeders in this region by replacing the local millet grains partially and completely replacing yellow corn and knowing the nutritional value for millet grains and chemically analyzed "before and after soaking and inserting them into diets in their normal form or soaked with citric acid in place of imported yellow corn in broiler performance.

Materials and Methods:

This experiment was conducted at the poultry farm of Faculty of Agriculture, Kufa University. In this study, 300 one-day-old unsexed Ross chicks with 38 g initial body weight were used. The chicks were divided into 5 groups and 3 replications, 20 chicks in each. Each group was housed separately in pens. The chicks were fed standard starter rations (from 1 to 21 days), and finisher (from 22 to 35 days). The ingredients analyzed chemically before mixing the diets according to Table (1). Diets were formulated

iso nitrogenous according to (NRC, 1994) Table (2). Millet grains were soaked in dilute citric acid solution at concentrates of 1.5% according to Areaaer, (2015) and dried before mixed in diets.

Study treatments were as follow; T1: control diet contained corn as main grain, T2: normal millet as main grain, T3: soaked millet in citric acid as main grain, T4:50% corn + 50% normal millet and T5: 50% corn+50% soaked millet in citric acid. Birds were housed in an environmentally controlled system and growing conditions. Birds were vaccinated according to program of veterinary medicine hospital in the region.

Experimental procedure:

Each experimental group was fed ad-libitum with its own diet for 35 d. Feed intake, gain weight and feed conversion ratio was determined in each period weekly. The study was conducted according to the International Guidelines for Research Involving Animals (Directive 2010/63/EU, especially slaughtering birds according to the Islamic procedures).

Performance traits:

Feed intake and body weight gain were recorded for the period at the beginning of the experiment (1d) until the end of the starter period 21thd of age, and finisher period 22th-35nd d of age (Alkassar, 2018). Feed conversion ratio (FCR) was calculated by dividing feed intake by body weight gain (Alkassar, 2010). On the final day of the experiment, at 35d-of-age, two birds from each replicate (six from each treatment) were randomly selected slaughtered and dissected manually, plucked and eviscerated. The viscera were removed as for the usual dressing of poultry carcasses. Heart, liver (free of the gall bladder), also empty skinned gizzard was trimmed of extraneous tissue and weighed individually and their sum of weights 'giblets' was taken. The dressed weights obtained were expressed as a percentage of the live weights and carcass cuts expressed as a percentage of dress carcass weight.

Statistical analysis:

The data obtained from the experiment was analyzed using (SAS, 2001) with a general linear models' procedure for ANOVA. Differences between means were analyzed using Duncan's multiple tests (Duncan's, 1955).

Table (1): The chemical analysis of ingredients in all diets

Nutrient %	Corn	Millet	Wheat	Soybean meal
Moisture	9.5	10.5	11.0	8.0
Dry matter	90.5	89.5	89.0	92.0
Crude protein	8.5	12.0	13.6	48.0
Ether extract	3.5	3.0	2.1	2.6
Crude fiber	2.5	5.0	3.2	6.4
Nitrogen free extract (NFE)	74.0	64.0	69.1	24.0
Ca	0.05	0. 6	0.05	0.7
P	0.08	0. 2	0.3	0.96
ME kcal / kg	3350	3000	3250	2230

Bioactive compound in millet		
Compound(ppm)	**Before-soaked in citric acid**	**After -soaked in citric acid***
Phenols	5.8	0
Flavonoid	47.48	31.54
Alkaloid	3.6	0.56
Tannin	8.4	0

***pH value of acidotic solution =3.0**

Table (2): Basal diets for all treatments

Stages	Starter					Finisher				
periods	0-3 weeks					4-5 weeks				
Ingredients (%)	T1*	T2	T3	T4	T5	T1	T2	T3	T4	T5
Corn	50.0	-	-	25.0	25.0	55.0	-	-	27.5	27.5
Wheat	8.0	9.8	9.8	8.8	8.8	9.9	8.11	11.8	11.0	11.0
Millet	-	50.0	-	25.0	-	-	55.0	-	27.5	-
Millet soaked in acetic acid	-	-	50. 0	-	25.0	-	-	55.0	-	27.5
Soybean meal	36.9	32.8	32.8	34.9	34.9	28.5	24.0	24.0	26.1	26.1
Premix**	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Corn oil	1.6	3.9	3.9	2.8	2.8	3.1	5.7	5.7	4.4	4.4
Di Calcium phosphate	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Limestone	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100	100	100	100	100	100
Calculated chemical analysis										
ME (kcal/kg)	3024	3023	3023	3026	3026	3201	3204	.3204	3204	3204
Crude protein (%)	23.5	23.5	23.5	23.5	23.5	20.2	20.2	20.2	20.1	20.1
Total Ca (%)	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07
Avail. Phosphorus (%)	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Lysine (%)	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
Methionine (%)	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Methionine + Cysteine	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Crude fiber (%)	3.86	3.86	3.86	3.86	3.86	3.56	3.56	3.56	3.56	3.56
Calorie: Protein Ratio	128. 6	128.5	128.5	128.7	128.7	156.0	156.5	156.5	156.6	156.6

***T1:(50% Corn), T2:(50% normal pearl millet), T3:(50% millet soaked in citric acid), T4:(25% corn + 25% normal millet), T5:(25% corn + 25% millet soaked in citric acid).**

****Jordanian premix (provimi): contains ME 4900 kcal/kg, crude protein 18%, fat 1.1%, calcium 15-19%, lysine 9.4%, available phosphorus 13.1%, sodium 4.8%, chlorine 5.8% , Methionine 7.8%, methionine + cysteine + MHA 7.8%, threonine 0.55%, and it contains a mixture of vitamins and trace minerals to secure the needs of the bird, with some enzymes (phytase, alpha-amylase, glyconase).**

Results and Discussion:

Table (3) shows that body weight gain (BWG), feed intake, feed conversion ratio (FCR), are significantly improved (P<0.01) by feeding millet grain soaked in citric acid (T3) as a main cereals instead of corn than all treatments and gave 809.8 g/bird Vs. 587.1 g/bird in control group (T1) in starter periods, but it didn't differentiated significantly at finisher periods. Also, T2 and T3 recorded significant (P<0.05) high value at total periods 2035.7, 2022.2 g/bird Vs 1779.0 in T1 respectively, this may be due to the efficiency of the absorption of nutrients, resulting in higher rates of metabolism inside the body (Adnan *et al*., 2016).

The highest feed consumption differed significantly (P<0.05) at finisher and total periods only since T3, which recorded 1982.0 and 3076.3 g/bird, and the lowest feed consumption was observed in control group (T1) 1731.3 and 2617.7 g/bird respectively. While there were no significant differences at all periods, may be due to the significant decrease in the concentrations of anti-nutrients in millet grains as a result of soaking with acid solutions, as the amount of tannins reached 8.4 ppm with millet before soaking and became zero parts per million after soaking, and thus resulted in an increase in digestion the nutrients and minerals and then increase their absorption to achieve higher rates of metabolism within the bird's body (Adnan *et al*., 2016؛ Pawar and Machewad, 2006) .

Table (3): Average of some productive traits of broiler at (0-3), (4-5) and (0-5) weeks of age.

Treatment No	Body weight gain (g/bird)			Feed consumption (g/bird)			Feed conversion ratio		
	0-3wk	4-5wk	0-5wk	0-3wk	4-5wk	0-5wk	0-3wk	4-5wk	0-5wk
T1*	587.1^{c} ± 2.8	1200.7 ± 6.38	1779.0^{c} ± 11.59	885.9 ± 32.1	1731.3^{c} ± 25.7	2617.7^{c} ± 57.5	1.50 ± 0.04	1.43c ± 0.02	1.46 ± 0.02
T2	731.1^{ab} ± 9.6	1304.7 ± 6.48	2035.7^{a} ± 4.40	989.3 ± 15.6	1965.7^{a} ± 18.7	2954. 7^{b} ± 13.4	1.35 ± 0.01	1.50^{bc} ± 0.00	1.45 ± 0.005
T3	811.2^{a} ± 23.46	1211.0 ± 4.93	2022.2^{a} ± 23.46	660.4 ± 28.4	1996.3^{ab} ± 5.66	3111. 7^{a} ± 37.87	1.37 ± 0.03	1.64^{a} ± 0.00	1.53 ± 0.017
T4	642.0^{bc} ± 55.9	1232.3 ± 9.82	1874.0^{bc} ± 31.74	1005.3 ± 117.3	183.7^{bc} ± 71.6	2840.0^{b} ± 168.0	1.56 ± 0.10	1.47^{bc} ± 0.02	1.51 ± 0.02
T5	660.4^{bc} ± 28.40	1184.0 ± 46.03	1844.4$^{b\,c}$ ± 28.40	881.7 ± 94.63	1922.3^{abc} ± 61.33	2804.3^{ab} ± 106.90	1.34 ± 0.18	1.61^{a} ± 0.01	1.52 ± 0.06
Significant	**	NS	*	NS	*	*	N.S	**	N.S

***T1:(50% Corn), T2:(50% normal pearl millet), T3:(50% millet soaked in citric acid), T4:(25% corn + 25% normal millet), T5:(25% corn + 25% millet soaked in citric acid).**

^{a,b,c} Means bearing different superscript in a column differ significantly **(P<0.0l), *(P<0.05).

The significant improvement in the feed conversion factor due to the increase in the weight gain rates for the birds of these treatments as a result of the presence of the highest level of amino acid balance, and their quality present in millet grains is better than that found in yellow corn, in addition to the quality of the fatty acids in the fat of millet grains, with the breakdown of some fibers and complex carbohydrates during soaking with acids, an increase in the quantity and quality of the bird's nutrient to make the bird express its genetic capabilities as much as possible through the least amount of feed consumed to achieve the highest rates of weight gain.

On the other hand, the steeping process has an important role in increasing the effectiveness of enzymes in the release of nutrients, and thus the birds' benefit from them and raising the feed conversion ratio (Yasar and Forbes, 1999). The results of the current study agreed with (Adil *et al*., 2011) who showed that there were no significant differences in the feed conversion ratio between birds in the control group and treatment birds with organic acids added to them.

All birds which consumption diets contained normal and soaked millet as a sole source of grains appears significant differences (P<0.01) in carcass traits (Table 4), hot carcass weights and dressing percentage at age 35d. T2 recorded the highest value in hot carcass weights, 1473.8g, Vs. the lowest 1205.17 g in T1 (control group),and the highest dressing percentages without edibles in T2 69.91% Vs. 65.5% in T1 respectively, but there was a clear significant (p≤0.05) in relative weight of heart in T1 0.67 Vs. the lowest value in T3 0.57%. Relative gizzard weight appears significant (P<0.01) increasing in T1 2.82%, liver 2.81%. abdominal fat in T5 1.24%. The carcass cuts appear significant differences among all treatments, the highest value in thigh in T3 30.19% Vs. the lowest in T5 25.58%, breast T5 37.31% Vs in T1 34.99%, back T5 recorded 19.1% Vs in T3 17.26%, wings T5 10.36% Vs T1 9.7%, neck T3 7.72% Vs T4 6.41%.

The averages of dressing percentage appear to be consistent with the live weights of birds (Pandurevic *et al*., 2014) and shows that there is a strong correlation coefficient between the average weight before slaughter and the dressing percentage, which reached 0.7 in males and 0.89 in females. The results of this study agree with Kokoszynski *et al*., (2017) who observed a low correlation coefficient (0.3 = r)

between average body weight and internal viscera weight, also our results agree with Abdul-Abass and Areaaer, 2014.

Table 4. Dressing percentage, edibles, Abdominal fat.

Treatments ± SEM							
Treatment No	**Live B.W (g)**	**Hot carcass. Weight (g)**	**% Dressing Without edible**	**% Heart**	**% Liver**	**% Gizzard**	**% Abdominal fat**
T1	1840.0^{c} ± 0.00	c 1205.17 ± 5.86	65.50^{d} ± 0.33	a 0.67 ± 0.00	bc 2.60 ± 0.02	2.82^{a} ± 0.07	c 1.20 ± 0.08
T2	2095.0^{a} ± 5.00	1473.83^{a} ± 3.71	69.91^{a} ± 0.33	abc 0.63 ± 0.02	a 2.81 ± 0.06	2.13^{d} ± 0.02	c 1.20 ± 0.04
T3	2065.0^{b} ± 0.00	1407.7^{c} ± 7.91	67.92^{c} ± 0.31	0.57^{c} ± 0.01	2.36^{d} ± 0.03	2.15^{d} ± 0.04	1.26^{b} ± 0.03
T4	1936.3^{b} ± 9.94	1330.50^{b} ± 10.78	67.74^{b} ± 0.84	ab 0.64 ± 0.02	bc 2.58 ± 0.03	2.31^{c} ± 0.04	ab 1.29 ± 0.01
T5	1920.0^{c} ± 7.93	1290.0^{d} ± 12.33	67.09^{cd} ± 0.46	0.60^{bc} ± 0.02	2.68^{ab} ± 0.02	2.61^{b} ± 0.01	1.34^{a} ± 0.06
Significant	**	**	**	*	**	**	**

***T1:(50% Corn), T2:(50% normal pearl millet), T3:(50% millet soaked in citric acid), T4:(25% corn + 25% normal millet), T5:(25% corn + 25% millet soaked in citric acid).**

^{a,b,c} Means bearing different superscript in a column differ significantly **(P<0.0l), *(P<0.05)

Table (5): Carcass cuts and intestinal morphological

Treatment. No	**% Thigh**	**% Breast**	**% Back**	**% Wings**	**Small Intestinal. Length(cm)**	**Relative intestinal length.cm / g**
T1	28.89^{a} ± 0.29	34.99^{bc} ± 0.30	18.89^{b} ± 0.17	9.70^{cd} ± 0.05	193.50^{b} ± 2.08	10.89^{a} ± 0.21
T2	28.48^{a} ± 0.42	36.77^{ab} ± 0.49	17.97^{bc} ± 0.04	9.94^{c} ± 0.02	204.16^{a} ± 0.44	9.78^{b} ± 0.01
T3	30.19^{a} ± 0.48	34.64^{c} ± 1.15	17.26^{d} ± 0.47	10.14^{bcd} ± 0.10	191.33^{b} ± 0.44	9.22^{c} ± 0.02
T4	27.67^{ab} ± 0.71	37.31^{a} ± 0.69	19.10^{a} ± 0.29	10.36^{a} ± 0.07	199.33^{a} ± 3.46	10.66^{a} ± 0.35
T5	29.76^{a} ± 0.24	36.44^{abc} ± 0.14	16.00^{e} ± 0.04	10.25^{bc} ± 0.04	204.66^{a} ± 0.83	10.86^{a} ± 0.08
Significant	*	*	**	**	**	**

***T1:(50% Corn), T2:(50% normal pearl millet), T3:(50% millet soaked in citric acid), T4:(25% corn + 25% normal millet), T5:(25% corn + 25% millet soaked in citric acid).**

^{a,b,c} Means bearing different superscript in a column differ significantly **(P<0.0l), *(P<0.05)

Conclusion:

The possibility of partially or completely replacing millet with the yellow corn in a broiler diet being better than yellow corn grain, the possibility of soaking millet with citric acid to improve its nutritional value The process of soaking millet with citric acid reduced the effect of nutritional inhibitors. Especially tannin and phenols High palatability of the diets due to the presence of a relatively sour taste in it. The cost of one ton of local Iraqi pearl millet is 276 $/ton compromised with imported yellow corn is 448$/ton, So the cost of locally millet is equivalent to 60% of the cost of yellow corn. Significant difference in economic cost, as the diets containing millet were less about 26.5% per ton than the diets of imported yellow corn**,** this result agreement with (Nihad, et al,2018)

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