EFFECT OF FEEDING CORN- OR WHEAT-BASED DIETS SUPPLEMENTED WITH ENZYME AND PROBIOTIC ON PRODUCTIVE PERFORMANCE OF SEXED BROILER CHICKENS

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ABSTRACT

The present study was carried out to evaluate different feedstuff sources (corn- or wheat-soybean), complex exogenous enzyme and/or probiotics supplementation to broiler diets. A total of nine hundred and sixty sexed broiler chicks were used in this study. Chicks were randomly distributed into 32 pens (30 Ross 308 chicks per pen). For each sex, 16 replicate pens were allocated. Eight dietary treatments were formulated in three phases feeding regimen: The treatments were as follows: (T1 and T5) Control group (0.0%, no enzyme or probiotic addition), T2 and T6) the corn- or wheat-based diet supplemented with 0.02% exogenous enzyme (EE), T3 and T7) the corn- or wheat-based diet supplemented with 0.10% probiotics (P) and T4 and T8) the corn- or wheat-based diet supplemented with 0.12% of combination of EE+P fed for both sexes. Body weight (BW), gain (BWG), feed consumption (FC), feed conversion ratio (FCR) was studied. In general, birds (males or females) fed wheat based-diets either alone or supplemented with exogenous enzyme complex and /or probiotics achieved significantly ($p<0.0001$) greater BW, BWG and FCR than counterparts fed on corn-based diets at all ages studied. Supplementation of enzyme and probiotics to birds fed corn –based diets had negative effect on BWG from 1to 21d of age, but from 22 to 42 d of age supplementation with exogenous enzyme achieved greater BWG over control group. Whereas, supplementation of probiotics to wheat-based diets showed positive significant effect on BWG at all ages in males, but not in females. Neither enzyme supplementation nor probiotics have positive effect on FCR with two types of cereals based diets. The most negative effects were shown in group fed either corn- or wheat-based diets supplemented with combinations of enzyme and probiotics. In conclusions, with respect to Ross-308 broilers, birds fed on wheat-based diets showed significant improvements in performance than those fed corn-based diets. In general, the efficency of enzyme and probiotics use is negligible with corn-based diets, whereas, only probiotics detected beneficially with wheat-based diets.

INTRODUCTION

In Europe, for example, the main cereal grains used in broiler ration is wheat, while, in USA, the main cereal grain is corn (23) due to huge production of such cereals at these countries. Therefore, gene expression and genetic makeup of birds may differ accordingly, because, they selected for performance while being fed wheat- or corn soybean type feed (23). Leclercq (19) observed that the lean birds are less tolerant to low protein than those selecting for fast-growing. Pym *et al*. (28) concluded that energy and nitrogen metabolism depend mainly on selection strategy of broilers.

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Moran *et al*. (23) found that the Ross broiler strains developed in UK had more beneficial from wheat-based diets than fed on corn-based diets. Rougiere and Carre (30) reported that the mean retention time of nutrients in digestive organs differ significantly among chicken genotypes. In some situations, feed mill is not taking into account this idea due to diet formulation according to price and availability of feedstuffs. Corn was used extensively in worldwide broiler diets due to availability and do not pose a viscosity problems (33). However, in corn/soybean- based diets, Cowieson (7) demonstrated that the chemical composition and nutritional values of corn are variable and can be improved via enzyme supplementation. Meanwhile, the inherent ileal digestibility of starch, protein and lipid in a corn/soy-based diets varying from around 70% to over 95% due to various reasons (8). Whereas, Slominski (33) reported that when using enzyme specific to corn–SBM based diets and its non-starch polysaccharides (NSP), less successful responses was noted due to inconsistent between enzyme type and substrate.

On the other hands, wheat is another cereal grain used especially and extensively in broiler diets in EU countries, because these countries produce huge amounts of wheat valwed around 40% of total product used in poultry feeds. Wheat is also used in poultry feed in other developing countries as a major cereal grain. It was contained the specific anti-nutritional factors, so called viscous NSP, that have negative effect on poultry because of its lack or have insufficient endogenous enzyme to complete degradation of NSP cell wall. Therefore, to eliminate this unfavorable feature of such feed ingredients, exogenous enzyme is widely used to breakdown cell walls in feed to reduce the viscosity of digesta and to improve the digestibility of carbohydrates and proteins (4). The response of chicks to exogenous enzyme may inconsistent with the substrate of feedstuffs used in diets (33) or related with birds genetic make-up which made it able to benefit from plant feedstuffs, even from relatively young age, without need to add exogenous enzyme due to efficient conversions (34).

Probiotics are live beneficial microorganisms that introduce into the digestive tract by poultry feeds as protective microorganisms. Patterson and Burkholder (27) reported that competition of beneficial bacteria with the pathogenic bacteria for adhesive sites of the gastrointestinal tract (GIT), stimulate appetite, improve host's intestinal microbial balance, improve intestinal environment for the processes of digestion and absorption of nutrients and inhibit the growth of certain pathogens that produce toxic compounds. The use of probiotics in broiler feeds was investigated extensively (13, 14, 15, 18, 36, 38 and 40) but conflict results were obtained.

In this study, different feedstuffs source (corn- or wheat-soybean), enzyme complex and /or probiotics supplementation were compared using Ross-308 strain of broilers developed genetically in UK. Little information available about how feedstuffs represented at pure lines level affecting performance of limited strains that spread across worlds. In addition, to our knowledge, studies were condueted on the Ross broiler chickens to inclusion of probiotics, either alone or in combinations with exogenous enzyme to diets differ in main feedstuffs cereals type.

The aim of this study was to evaluate the performance of both sexes of Ross-308 broilers strains fed corn/ or wheat/soybean-based diets supplemented with complex exogenous enzyme and/or probiotics.

MATERIAL AND METHODS

BIRDS AND HOUSING

A total of 960 commercial sexed broiler chicks (Ross 308) day old were randomly distributed into 32 pens (30 chicks per pen). For each sex, 16 replicate pens were allocated. Chicks were housed on wood shavings floor pens (1.75 x 3 m) at Poultry Research Station / Ministry of Agriculture over the period from 8 Oct 2013 to 19 Nov 2013. Temperature being kept at 32° C for first 3 d and then reduced to 31° C at day 7 and gradually decreased by 2° C every week to reach 22° C. Feed and water were provided *ad libitum*. Birds were subject to 23L:1D h (light: dark) lighting regimen. Vaccination against infectious bronchitis was done at the hatchery, while Newcastle disease followed at one and third weeks of age, and infectious bursal disease followed at two and fourth weeks of age. This study was conducted in accordance with guideline of Canadian Council on Animal care and use of laboratory animals and approved by the Office of Agricultural Research Ethics Committee that recently done in Iraq (2014/5849).

TREATMENTS

DIETS AND FEED PREPARATION

All birds were fed nutritionally complete-commercial diets *ad libitum* as recommended by Ross 308 broiler company guide (2). Isocaloric and isonitrogenous diets were formulated in three phases (a starter from 1to 10 d of age; a grower from 11to 24 d of age; a finisher from 25 to 42 d of age) of broiler feed (Table 1). Corn or wheat was the only cereal grains used to formulate experimental diets. Soybean meal represented the primary source of protein for all feeds. Protein concentration package (Wafi-type, The Netherland) was a secondary protein source for all feeds and the same proportion were used with each formulation. Feed was prepared as mash basis. In the grower and finisher phase a 10 to 15% of whole wheat grain was presented to birds without grinding. Enzyme supplementation (XVET, Germany) included activities of Xylanase (630.000U/Kg), β-glucanase (30.000 U/Kg), Protease (12.000 U/Kg), α-Amylase (1.200 U/Kg) and Phytase (2.500FYT/Kg). Probiotics supplementation (BioSB-Gold, 1062-4 Namhyun-Dong Gwanak-Gu, Seoul, 151-801 Korea) included activities of live *Saccharomyces cerevisiae* (more than 3.0 x 10^{11}cfu/ Kg) and *Bacillus subtilis* (more than 4.0x 10^{9}cfu/Kg) and Biomass metabolites (q.s). All rations were prepared for one week interval with small amount (100 kg per diets). All supplements (additives) were mixed with synthetic amino acid, dicalcium phosphate and small part of protein concentrate by hand until homogenized (to insure mixing) and then placed with the major elements in mixer. Furthermore, diets were also supplemented with mold killer to prevent negative effects of aflatoxin or mycotoxin in corn or in wheat.

MEASUREMENTS

Body weight at 1, 21 and 42 day of age , body weight gain (BWG), Feed consumption (FC) and feed conversion ratio (FCR) during the period from 1 to 21, 22 to 42 and 1 to 42 d of age were determined by pen (replicate). FCR was adjusted for mortality by adding the weight of dead birds to the total pen weight (13).

STATISTICAL ANALYSIS

The experiment was conducted as a completely randomized design of two-way analysis of variance where the cereal types and dietary treatments as a main effects. The interaction of cereal types and dietary treatments were also

evaluated. Each sex was analyzed separately. Data were analyzed by General Linear Model (GLM) procedure of SAS (31). Differences were considered significant at ($p \leq 0.05$).

Table 1: Ingredients and chemical analysis of control diets[1]

Ingredient and composition	Starter (1-10 days of age)		Grower (11-24 days of age)		Finisher (25-42 days of age)	
	Corn-based	Wheat-based	Corn-based	Wheat-based	Corn-based	Wheat-based
Corn	54.10	----	59.16	----	63.22	----
Wheat	-----	55.63	-----	61.32	-----	64.94
Soybean meal (48% CP)	35.85	32.70	30.40	26.50	26.40	22.70
Protein concentrate[2]	5.00	5.00	5.00	5.00	5.00	5.00
Vegetable oil (Palm)	2.60	4.30	3.60	5.40	3.70	5.70
DL-methionine	0.21	0.20	0.14	0.13	0.08	0.06
L- lysine HCL	0.04	0.07	----	0.05	----	----
Dicalcium Phosphate[3]	0.50	0.30	0.50	0.30	0.40	0.80
Limestone	1.60	1.70	1.10	1.20	1.10	0.70
Salt	0.10	0.10	0.10	0.10	0.10	0.10
Calculated Analysis (%)[4]						
ME (Kcal/Kg feed)	3026	3029	3153	3151	3200	3201
Crude protein	23.80	23.80	21.60	21.50	20.00	20.00
Crude fiber	3.60	3.70	3.40	3.50	3.30	3.40
Crude fat	5.10	5.70	6.30	6.90	6.50	7.20
Lysine	1.43	1.43	1.25	1.26	1.14	1.14
Methionine+ Cystine	1.07	1.07	0.95	0.95	0.85	0.85
Calcium	1.10	1.11	0.90	0.90	0.87	0.89
Phosphorus Available	0.46	0.45	0.45	0.44	0.43	0.43

[1]: Ingredients for each diets sums 100%. The 0.12% corresponds to 0.02, 0.10 and 0.12% for enzyme (E), probiotics (P) and combination of both (E+P) supplementations for both diets types.
[2]Protein concentrate (Wafi B.V. ALBLASSERDAM-Holland) provided per Kg : 2150 ME Kcal/Kg ; 40 % crude protein; 4.1 % Methionine + Cystine ; 3.85 % Lysine ; 5.6 % Calcium ; 4.65 % Available phosphorous ; 5 % Crude fat; 2 % Crude fiber and other nutrients (vitamins + minerals) exceed the NRC (24) specifications.
[3]Dicalcium phosphate provided: 24% Ca and 18% Avail. P.

RESULTS AND DISCUSSION

Body weight (BW) and Body gain weught (BWG), feed consumption (FC) and feed conversion ratio (FCR) of males broilers are presented in table 2 and 3. The Main effects of cereal types showed that feeding on wheat based-diets achieved significantly ($p<0.0001$) greater BW, BWG, lower FC and better FCR from 1 to 21, 22 to 42 and 1 to 42 day of age than those fed on corn –based diets. Males feeding wheat based-diets alone had achieved significantly ($p<0.0001$; $p<0.0003$) and greater BW at days of 21 (12.05%) and 42 (8.38%) respectively compared with those fed corn based diets alone. Also, the main effect of diets showed that the supplementation of enzyme and combination of enzyme and probiotics couldn't cause any improvement in BW and BWG compared with control group whereas the improvement in BWG was observed in males fed diets supplemented with probiotics. In general, the supplementation of enzyme, probiotics and combination of enzyme and probiotics to male diets tend to increase FC compared with control group. FCR was better in control group than other dietary treatments.

The interaction of cereals type by diets showed on significant effect ($p<0.0422$) on BW at 21 d and highly significant effect ($p<0.0001$) on BWG, FC and FCR till 42day of age. Males fed on corn-based diets alone exhibited greater FC and FCR, numeric, during theperiod from 1to 21, 22 to 42 and 1 to 42 d of age compared with their counterparts fed on wheat-based diets alone. Males fed corn –based diets supplemented with exogenous enzyme or probiotics had

negative effect on BW, BWG and FCR and higher FC from 1 to 21d of age but combination of exogenous enzyme and probiotics was not varied from control group. Positive effect of exogenous enzyme or probiotics on BWG, but not on BW, was observed from 22 to 42 day of age (1721 and 1718 *vs* 1652 g) and from 1 to 42 day of age for birds fed on corn-based diets. On the other hands, beyond 22 to 42 d of age, birds fed on corn based-diets supplemented with combination of exogenous enzyme and probiotics exhibited significantly lower BWG and FC and greater FCR than their counterparts fed corn-based diet alone or supplemented with exogenous enzyme or probiotics. Males fed on wheat based-diets supplemented with probiotics showed positive significant effect on BW, BWG and FC but not with FCR. Exogenous enzyme supplementation to corn or wheat based diets couldn't achieve any improvement in BWG and FCR compared to on control group. Reduction in BW, BWG and FCR was observed in males fed wheat-based diet supplemented with combination of enzyme and probiotics at all ages. Enzyme supplementation to corn-based diets was increased FC significantly from 22 to 42 and 1to 42 d of age. But in wheat-based diets, FC was increased only durig 1to 21 d of age. Furthermore, in general, males fed corn-based diets supplemented with either complex exogenous enzyme and/or probiotics appeared deleterious effect in FCR. Whereas, neither enzyme supplementation nor probiotics have positive effect on FCR in males fed wheat-based diets. The most detrimental effects were showed in group of birds fed either on corn- or wheat-based diets supplemented with combinations of enzyme and probiotics.

Table 2. Influence of exogenous enzyme, probiotic and their combinations on the body weight and weight gain of male broilers fed corn- or wheat- based diets

Item		Body weight, g			Body Weight gain ,g/bird		
Cereal	Diet[1]	d1	d 21	d 42	d 1-21	d 22-42	d 1-42
Corn	C	46	772^{d}	2430^{cd}	732 ^{d}	1652 ^{c}	2384 ^{cd}
	E	47	731^{e}	2453^{c}	685 ^{e}	1721 ^{b}	2406 ^{c}
	P	46	743^{e}	2461^{c}	697 ^{e}	1718 ^{b}	2414 ^{c}
	E+P	46	778^{d}	2338^{e}	732 ^{d}	1560 ^{c}	2291 ^{e}
Wheat	C	47	884^{b}	2653^{b}	838 ^{b}	1768 ^{b}	2606 ^{b}
	E	47	880^{b}	2625^{b}	834 ^{b}	1744 ^{b}	2578 ^{b}
	P	46	911^{a}	2757^{a}	865 ^{a}	1846 ^{a}	2711 ^{a}
	E+P	46	856^{c}	2362de	810 ^{c}	1506 ^{d}	2316 ^{de}
Main effect, Cereals							
Corn		46	758^{b}	2420^{b}	711 ^{b}	1663 ^{b}	2374 ^{b}
Wheat		46	883^{a}	2599^{a}	836 ^{a}	1716 ^{a}	2553 ^{a}
Main effect , Diets							
C		46	831	2541^{a}	785 ^{a}	1710 ^{b}	2495 ^{b}
E		47	806	2539^{a}	759 ^{b}	1732 ^{b}	2492 ^{b}
P		46	827	2609^{a}	780 ^{a}	1781 ^{a}	2563 ^{a}
E+P		46	817	2450^{b}	771 ^{ab}	1533 ^{c}	2303 ^{c}
SEM, pooled (±)[2]		0.14	17.36	37.85	12.06	19.81	26.32
Source of variation		Probability					
Cereals		0.5136	0.0001	0.0003	<0.0001	0.0010	<0.0001
Diets		0.3602	.0.3366	0.0013	0.0158	<0.0001	<0.0001
Cereals x Diets		05406	0.0422	0.0556	<0.0001	0.0004	<0.0001

[a-e] Means assigned different superscript letter within each factor are significantly different , P≤0.05.
[1]: Diets of C, E, P and E+P represent: control (no supplementation), , enzyme, probiotic and their combinations, respectively.
[2]: SEM: standard error of mean.

Table (4) revealed that the females fed on corn-based diets exhibited significantly (p<0.0001) lower BW at 21 d and BWG from 1 to 21 day of age and

significantly (p<0.0052) greater BWG from 22 to 42 day of age than that fed on wheat-based diets. The results on FC and FCR are shown in Table 5. Lower FC and better FCR was observed in females fed on wheat-based diets. Females fed on corn-based diets either alone or with enzyme and/or probiotics supplementation eats more feed and inferior FCR (high number) than those of wheat-based diets group. Also, main effect of diets showed that the supplementation of enzyme and combination of enzyme and probiotics caused significant reduction in BW and BWG compared with control group. FC was also lower in females fed diets supplemented with exogenous enzyme, probiotics and their combinations during the period from 22 to 42d and from 1 to 42 d of age. Better FCR was observed in females fed diets supplemented with exogenous enzyme compared with those supplemented with probiotics or combination of enzyme plus probiotics.

The significant interaction effect of cereal types by diets was found on BW at 42 d and BWG, FC and FCR at all ages studied. Females fed wheat-based diets showed greater BW, BWG and FC than other dietary treatments. FCR was better in females fed wheat-based diets supplemented with exogenous enzyme. The more detrimental effect on performance was noticed in group of females fed on wheat-based diets supplemented with combination of enzyme plus probiotics.

Table 3: Influence of exogenous enzyme, probiotic and their combinations on the feed consumption and feed conversion ratio of male broilers fed corn- or wheat- based diets

Item		Feed consumption, g/bird			Feed conversion ratio[2] , g/g		
Cereal	Diet[1]	d 1-21	d 22-42	d 1-42	d 1-21	d 22-42	d 1-42
Corn	C	1331 ^{b}	3358 ^{b}	4689 ^{b}	1.82 ^{cd}	2.14 ^{bc}	2.03 ^{c}
	E	1373 ^{ab}	3861 ^{a}	5235 ^{a}	2.00 ^{ab}	2.19 ^{bc}	2.13 ^{b}
	P	1456 ^{a}	3335 ^{b}	4791 ^{b}	2.10 ^{a}	2.03 ^{c}	2.04 ^{c}
	E+P	1369 ^{b}	3266 ^{b}	4635 ^{b}	1.94 ^{bc}	2.41 ^{a}	2.24 ^{a}
Wheat	C	1247 ^{c}	3081 ^{c}	4329 ^{c}	1.51 ^{e}	1.77 ^{d}	1.68 ^{e}
	E	1342 ^{b}	2989 ^{c}	4331 ^{c}	1.61 ^{e}	1.83 ^{d}	1.76 ^{de}
	P	1343 ^{b}	3386 ^{b}	4730 ^{b}	1.57 ^{e}	1.88 ^{d}	1.78 ^{de}
	E+P	1417 ^{ab}	3408 ^{b}	4825 ^{c}	1.76 ^{d}	2.48 ^{a}	2.21 ^{ab}
Main effect, Cereals							
Corn		1362 ^{a}	3455 ^{a}	4638 ^{a}	1.96 ^{a}	2.19 ^{a}	2.12 ^{a}
Wheat		1338 ^{b}	3216 ^{b}	4554 ^{b}	1.61 ^{b}	1.99 ^{b}	1.86 ^{b}
Main effect , Diets							
C		1289 ^{c}	3220 ^{c}	4509 ^{b}	1.66 ^{b}	1.95 ^{c}	1.86 ^{d}
E		1358 ^{b}	3425 ^{a}	4783 ^{a}	1.80 ^{a}	2.01 ^{b}	1.94 ^{b}
P		1400 ^{a}	3360 ^{b}	4761 ^{a}	1.83 ^{a}	1.95 ^{c}	1.91 ^{c}
E+P		1393 ^{a}	3337 ^{b}	4731 ^{a}	1.85 ^{a}	2.45 ^{a}	2.22 ^{a}
SEM, pooled(±)[3]		11.36	44.75	50.07	0.037	0.045	0.037
Source of variation		Probability					
Cereals		0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Diets		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cereals x Diets		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

[a-e] Means assigned different superscript letter within each factor are significantly different, P≤0.05.

[1]: : Diets of C, E, P and E+P represent: control (no supplementation), , enzyme, probiotic and their combinations, respectively.

[2]: Corrected for mortality.

[3]SEM: Standard error of mean

Table 4: Influence of exogenous enzyme, probiotic and their combinations on the body weight and weight gain of female broilers fed corn- or wheat-based diets

Item		Body weight, g			Body weight gain ,g/bird		
Cereal	Diet[1]	d1	d 21	d 42	d 1-21	d 22-42	d 1-42
Corn	C	47	742^{c}	2200^{b}	695 ^{c}	1458 ^{ab}	2153 ^{b}
	E	45	713^{d}	2207^{b}	667 ^{d}	1495 ^{a}	2162 ^{b}
	P	46	752^{c}	2214^{b}	706 ^{c}	1463 ^{ab}	2169 ^{b}
	E+P	45	708^{d}	2201^{b}	662 ^{d}	1493 ^{a}	2155 ^{b}
Wheat	C	45	830^{a}	2382^{a}	784 ^{a}	1551 ^{a}	2336 ^{a}
	E	46	802^{b}	2257^{b}	756 ^{b}	1455 ^{ab}	2211 ^{b}
	P	46	782^{b}	2175^{b}	736 ^{b}	1393 ^{b}	2129 ^{b}
	E+P	45	803^{b}	2054^{c}	758 ^{b}	1252 ^{c}	2010 ^{c}
Main effect, Cereals							
Corn		46	728^{b}	2206	683 ^{b}	1477 ^{a}	2160
Wheat		46	804^{a}	2217	759 ^{a}	1413 ^{b}	2172
Main effect , Diets							
C		46	786	2291^{a}	740 ^{a}	1505 ^{a}	2445 ^{a}
E		46	767	2232^{ab}	712 ^{b}	1475 ^{ab}	2187 ^{b}
P		45	757	2195^{ab}	721 ^{b}	1428 ^{bc}	2149 ^{b}
E+P		45	755	2128^{b}	710 ^{b}	1372 ^{c}	2082 ^{c}
SEM, pooled(±)[2]		0.19	11.38	25.08	7.94	17.69	17.44
Source of variation		Probability					
Cereals		0.5859	0.0001	0.7436	<0.0001	0.0052	0.5535
Diets		0.6985	0.1761	0.0506	0.0035	0.0010	<0.0001
Cereals x Diets		0.6688	0.1348	0.0469	0.0012	0.0001	<0.0001

[a-e] Means assigned different superscript letter within each factor are significantly different , P≤0.05.
[1]: : Diets of C, E, P and E+P represent: control (no supplementation), , enzyme, probiotic and their combinations, respectively.
[2]: SEM: standard error of mean.

Table 5: Influence of exogenous enzyme, probiotic and their combinations on the feed consumption and feed conversion ratio of female broilers fed corn- or wheat- based diets

Item		Feed consumption, g/bird			Feed conversion ratio[2] , g/g		
Cereal	Diet[1]	d 1-21	d 22-42	d 1-42	d 1-21	d 22-42	d 1-42
Corn	C	1249 ^{d}	3293 ^{a}	4542 ^{ab}	1.81 ^{bcd}	2.27 ^{a}	2.12 ^{a}
	E	1368 ^{a}	3317 ^{a}	4685 ^{a}	2.07 ^{a}	2.25 ^{a}	2.19 ^{a}
	P	1338 ^{ab}	3188 ^{ab}	4525 ^{ab}	1.90 ^{b}	2.34 ^{a}	2.19 ^{a}
	E+P	1214 ^{de}	3204 ^{a}	4419 ^{bc}	1.85 ^{bc}	2.31 ^{a}	2.16 ^{a}
Wheat	C	1311 ^{ab}	2971 ^{b}	4282 ^{c}	1.70 ^{de}	2.00 ^{b}	1.89 ^{b}
	E	1193 ^{e}	2443 ^{c}	3636 ^{e}	1.62 ^{e}	1.83 ^{c}	1.75 ^{b}
	P	1291 ^{c}	2615 ^{c}	3907 ^{d}	1.77 ^{cd}	1.98 ^{b}	1.90 ^{b}
	E+P	1182 ^{e}	2582 ^{c}	3763 ^{de}	1.58 ^{e}	2.11 ^{a}	1.90 ^{b}
Main effect, Cereals							
Corn		1292 ^{a}	3251 ^{a}	4543 ^{a}	1.91 ^{a}	2.29 ^{a}	2.16 ^{a}
Wheat		1244 ^{b}	2653 ^{b}	3897 ^{b}	1.67 ^{b}	1.98 ^{a}	1.86 ^{b}
Main effect , Diets							
C		1280 ^{b}	3132 ^{a}	4412 ^{a}	1.75 ^{b}	2.13 ^{b}	2.01 ^{ab}
E		1280 ^{b}	2880 ^{b}	4161 ^{bc}	1.85 ^{a}	2.04 ^{c}	1.97 ^{b}
P		1314 ^{a}	2901 ^{b}	4216 ^{b}	1.84 ^{a}	2.16 ^{ab}	2.04 ^{a}
E+P		1198 ^{c}	3893 ^{b}	4091 ^{c}	1.71 ^{b}	2.21 ^{a}	2.03 ^{a}
SEM, pooled(±)[3]		11.79	60.77	67.90	0.027	0.032	0.029
Source of variation		Probability					
Cereals		0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Diets		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0409
Cereals x Diets		<0.0001	<0.0001	<0.0001	<0.0001	0.0007	0.0013

[a-e] Means assigned different superscript letter within each factor are significantly different, P≤0.05.
[1] : Diets of C, E, P and E+P represent: control (no supplementation), , enzyme, probiotic and their combinations, respectively.
[2]: Corrected for mortality.
[3]SEM: Standard error of mean.

EFFECT OF FEEDSTUFFS TREATMENTS

In this study, birds fed on wheat-based diets as a sole source of cereal grains achieved better BWG and FCR than those fed on corn-based diets. This results was unexpected because of several studies proved that the wheat and its water soluble bad viscous NSP which caused poor performance compared with non-viscous cereals as corn (21). Indeed, the reasonable reason may be in respect with the Ross- strain *per se* where they are originated and selected in UK where the dominant cereal feedstuffs is wheat (23). Furthermore, the adaptation of Ross strain to wheat ration may enhance endogenous enzyme and beneficial microflora in their intestinal environment to digest non-starch polysaccharides (NSP) rich-diets efficiently or viscosity per se unlikely is not a major problem with respect to this strain. Also, the local Iraqi wheat may be low-NSP and have lowest levels of viscosity due to its harvest in late spring where ambient temperature exceed 30ºC which caused more starch available and more degradation in cell wall of wheat kernel. Choct et al., (6) observed high variability in wheat arabinoxylan level due to environment factors. Arabinoxylan is known to influence wheat nutritive value and consequently the effect on chicken performance.

On the other hands, local corn may infect with fungus toxin (aflatoxin and mycotoxin) and when fed to chicken could affect bird heath and consequently affect negatively on performance. Svihus (34) concluded that when using whole untreated cereals in large quantities, fast-growing broilers are able to digest starch more or less completely passage through the jejunum. Kiarie et al., (17) was also found that birds fed wheat-based diets achieved better performance than those fed corn-based diets either alone or when supplemented with xylanase enzyme.

EFFECT OF EXOGENOUS ENZYME TREATMENTS

Enzyme supplementation, in general, in both types of diets could not detect any improvement in performance, and we found negative effect of enzyme on BWG through 21 d of age in males fed on corn-based diets, whereas, from 22 to 42 d of age supplemented with exogenous enzyme achieved greater BWG over control group. These results are consistent with early research that showed no or little beneficial effect of enzyme complexes, including amylase and protease, on performance of broilers fed on sorghum-soybean meal diet or maize-soybean diet (10, 16, 20, 26). Rebole *et al*. (29) found that the enzyme supplementation (primarily xylanase and β-glucanase), to wheat- and barley –based diets alone or in combination with inulin, had no significant effect on broiler performance. In addition, other results showed negative impact on broiler performance (5, 37). Slominski (33) concluded that when using enzyme specific to corn–SBM based diets and its non-starch polysaccharides (NSP), less successful responses was noted due to inconsistent between enzyme type and substrate. More recent, Angel and Sorbara (1) stated that in order to optimize activity of endogenous and exogenous enzymes to improve digestibility, the changing passage rate to allow more time to act upon their substrates in an environment is an issue. However, on the other hand, improvement in growth performance was showed when birds fed corn-soybean meal diets supplemented with exogenous complex enzyme (35 , 39) or with xylanase alone (17). The results from this study suggest that sex, diet type, strain and enzyme type may be the factors that influences on efficiency of enzyme application. Also, we survey the most article impact in peer-reviewed journal and found that the responsiveness to exogenous enzyme

supplementation to corn-based diets was found in US strains such Arbor Acres or Cobb but not or little with UK strain (Ross-308). Also, we can say that the Ross strain could not response well to this type of exogenous enzyme when fed on wheat –based diets due to their ability to digest some of NSP feedstuffs efficiently without needing exogenous enzyme supplementation.

EFFECT OF PROBIOTICS TREATMENTS

Probiotics supplementation to wheat-based diets showed improvements in BWG at ages studied but not with corn-based diets in broiler males. However, supplementation of probiotics to wheat-based resulted consistent improvements in starter (1 to 21 d of age) and grower broiler production period over the control group and others treatments. In the present experiment, the improvement of BWG was occurred in growing and finishing period (22 to 42 d of age) for birds fed on corn-based diets. This result is agreement to the findings of Mohan *et al.* (22), who observed that the beneficial effect of probiotic on chicken occurred only after the 4th week of growth in corn-based diets, and with Yeo and Kim (38), who reported that average daily weight gain of chickens fed on probiotics was significantly increased during the first 3 weeks of growth but not during the 4th to 6th weeks of growth, and that Bai et al. (3) also showed improvement of average daily gain and FCR in group of broilers (Cobb strain and corn is a source of grain) fed dietary probiotics supplementations during the first 3 weeks of growth but not during the 4th to 6th weeks. Shahir et al. (32) also found improvement of BWG and FCR due to probiotic supplementation to broiler diets during the period from 7 to 21 days of age compared to control group.

Controversial results are found in literatures, some findings was showed improvement in BWG and market BW (13, 14, 18 , 22) and FCR (13 , 40) due to probiotics supplemented to broilers diets. Whereas, others studies (11, 12, 25) had not found differences in FCR between probiotic- treated birds and untreated control birds. However, These varying results may be due to many reasons: first, that with respect to differences in the bacterial strains used, type, origins of these strains, administration and ability to attach the GIT epithelial cells (9 , 13) second) that with respect to bird's environments and conditions (diets, stress factors, farm sanitization- which may kill all type of organisms , bird age, sex and feeding regimen). Also, we detect from previous studies and from our unpublished data that the beneficial from probiotics, mostly, occurred in Arbor Acres strain fed corn and opposite was noticed with Ross 308 strain that responded well to probiotics when fed wheat-based diets.

EFFECT OF COMBINATIONS OF ENZYME AND PROBIOTICS TREATMENTS

The most detrimental effect in performance was observed in group of birds fed on corn or wheat-based diets supplemented with combination of exogenous enzyme complex and probiotics. The reasons why the performance of birds fed on diet containing combinations of enzymes and probiotics were not clear, but it may have been due to that the two additives classify as microorganisms and which make over dosage to be occurred and consequences prevent beneficial live microbes to work properly due to competitions with each other's which enhance the unwanted pathogenic microbes to occupied the GIT epithelial cells.

In conclusion, the current finding showed that the strain of broiler is respond well when birds fed wheat- based diets "as is" and express on their potential properly. But when fed corn-based diets adversely effects are noticed

significantly. Also, the benefit in performance was occurred only when fed dietary probiotics supplementation than enzymes complex or combinations of them.

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تأثير التغذية بعلائق أساسها الذرة او الحنطة المدعمة بالأنزيمات والبروبايوتك في الاداء الإنتاجي لدجاج فروج اللحم المجنس

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الملخص

اجريت الدراسة الحالية بهدف تقويم مصادر علفية مختلفة (ذرة صفراء او حنطة–كسبة فول صويا) وإضافة الانزيمات و /أو البروبايوتك لعلائق فروج اللحم. استخدم في هذه التجربة **960** فرخاً مجنساً من سلالة روز **308**. وزعت الافراخ عشوائياً على **32** حجرة بواقع **30** فرخاً لكل حجرة ، وبواقع **16** حجرة لكل جنس. استخدمت ثماني معاملات تغذوية بثلاث مراحل تغذوية لتغذية الطيور وكانت المعاملات كما يأتي: المعاملات **1** و **5** مثلت معاملة المقارنة (**0.0**% إضافة انزيم او بروبايوتك للذرة او الحنطة)، المعاملات **2** و **6** علائق الذرة او الحنطة مضاف إليها الأنزيم بنسبة **0.02**% ، المعاملات **3** و **7** علائق الذرة او الحنطة مضاف إليها البروبايوتك بنسبة **0.10**% ، المعاملات **4** و**8** علائق الذرة او الحنطة مضاف إليها خليط الأنزيم والبروبايوتك بنسبة **0.12**%، درست كل من الزيادة الوزنية واستهلاك العلف ومعامل التحويل الغذائي لكلا الجنسين. بينت النتائج ان التغذية بعلائق الحنطة للذكور والإناث بغض النظر عن الإضافات التغذوية أدت الى تحسين معدل الزيادة الوزنية ومعامل التحويل الغذائي معنوياً (أ<**0.0001**) مقارنة بنظيراتها المغذاة بعلائق الذرة. أدت إضافة الأنزيمات أو البروبايوتك الى تأثيرات سلبية قي الزيادة الوزنية أثناء المدة من عمر يوم لغاية **21** يوماً في كل من الذكور والاناث. وعلى العكس أدت إضافة البروبايوتك الى علائق الحنطة إلى تحسين معدل الزيادة الوزنية في كل المدد للذكور فقط. ولم تؤد إضافة الأنزيم أو البروبايوتك الى تحسن معامل التحويل الغذائي في كلا النوعين من مصادر الحبوب. كما أدى إضافة خليط الأنزيم والبروبايوتك إلى إحداث تأثيرات سلبية كبيرة في أداء الطيور. يمكن الاستنتاج بانه فيما يخص سلالة روص **308**، فان التغذية بعلائق الحنطة يُعدّ مصدراً وحيداً للحبوب قد حققت افضل الأداء مقارنة بالتغذية بعلائق الذرة. وإن إضافة الأنزيم أو البروبايوتك أظهرت تأثرات سلبية عند التغذية في علائق الذرة، غير إن إضافة البروبايوتك لعلائق الحنطة قد حققت فائدة ملاحظة في الزيادة الوزنية لذكور فروج اللحم.

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