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EFFECT OF USING CORN DISTILLER'S DRIED GRAINS WITH SOLUBLES IN BROILER DIETS WITHOUT OR WITH ADDING GALZYM ON GROWTH PERFORMANCE AND SOME PHYSIOLOGICAL PARAMETERS

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ABSTRACT

The present study was carried out to investigate the effect of using 10 % and 20 % corn distiller's dried grains with solubles (CDDGS) as partial replacement for yellow corn and soybean meal with or without adding 0.05 % Galzym powder on productive performance, some blood plasma parameters and the immune response of broiler chicks. A total number of 240 day-old, unsexed broiler chicks were randomly assigned to six treatments 40 chicks each. The first group was fed basal (starter and grower-finisher) diets without supplements and considered as control (T1) group, the second group was fed as T1 plus 0.05 % Galzym (T2), the third group was fed 10 % CDDGS (T3), the 4th group was fed as T3 plus Galzym addition, the 5th group was fed 20 % CDDGS (T5), the 6th group was fed as T5 plus Galzym (T6).

The obtained results showed that final live body weight values increased by CDDGS replacement. The highest final live body weight, total feed intake and total body weight gain values were recorded by the birds fed 20 % CDDGS level with Galzym as compared to other experimental treatments. Also, the lowest total feed conversion values were recorded for the birds fed 20% CDDGS plus Galzym as compared to other experimental birds. The results showed that there were significant increase in the experimental treatments in plasma total protein and total triglycerides values compared with the control treatment. Moreover, there were insignificant increases in total cholesterol values compared with the control group. Also, there were significant decreases in plasma inorganic phosphorus values as compared to the control treatment. The specific immunity against avian influenza disease virus (AIDV) titer was significantly increased when using 10 % CDDGS with Galzym supplementation in the diets after vaccination as compared to other experimental samples. Also, there were insignificant differences in the Newcastle disease virus (NDV) titer after vaccination among all the experimental treatments.

It is concluded that using CDDGS up to 20% in broiler diets as partial replacement for yellow corn and soybean meal with or without Galzym supplementation improved growth performance of broiler chicks and enhanced the specific immunity against avian influenza disease virus titer, with no adverse effects on their physiological blood parameters.

Key words: Broiler, corn distiller's dried grains with solubles

INTRODUCTION

Recently, high ingredient costs have led to increasing use of co-product ingredients in poultry such as CDDGS. Corn Distiller's Dried Grains with solubles (CDDGS) is a co-product after corn starch is fermented for ethanol fuel using dry milling technology Davis (2001) and Butzen and Haefele (2008). It contains all the nutrients remaining in the corn kernel in which the non-starch nutrients are three times concentrated of the original nutritional value of the corn Davis (2001). Hence, CDDGS contains good source of energy, protein and available phosphorus. With the new processing technologies used in recently-built ethanol plants the nutrient profiles of CDDGS have improved and such CDDGS became available for feeding livestock Noll *et al.* (2007). One of the biggest challenges in using CDDGS as a source of feed is the variation in nutrient concentrations among CDDGS sources and processing plants Cromwell *et al.* (1993); Spiehs *et al.* (2002) and Belyea *et al.* (2004) .The high variability among sources was found especially for concentrations of lysine, methionine and minerals Swiatkiewicz and Koreleski (2008). Fastinger *et al.* (2006) noted that lysine concentration in five different sources of CDDGS ranged from 0.48 to 0.76%. These differences could be attributed to variation in original grain composition, efficiency of starch fermentation during ethanol production and fermentation scale up, different amount of solubles added back, and drying procedures Swiatkiewicz and Koreleski (2008). In addition, CDDGS contains considerable amount of antinutritional factors such as arabinoxylan Kim *et al.* (2008) and its high fiber 8.8 to 10.2% could affect the nutrient utilization in poultry and so limit the CDDGS dietary inclusion. The high fiber can also decrease the nutrient digestibility of other dietary ingredients Spiehs *et al.* (2002).Earlier work showed that feeding low level of CDDGS (approximately 5%) in broiler diets improved weight gains Day *et al.* (1972) and a higher inclusion level was not detrimental to growth performance when metabolizable energy and lysine level were constant and sufficient in the broiler diets Waldroup *et al.* (1981) Parsons *et al.* (1983). More recently, the 'new generation of CDDGS was utilized in poultry feed; incorporating 5%CDDGS in broiler starter diet and up to 12 to 15% in grower diet had no negative impact on production parameters Lumpkins *et al.* (2004) and Choi *et al.* (2008) while higher inclusion levels at 15 to 25% CDDGS decreased dressing percentage and breast meat yield Wang *et al.* (2007) and Lumpkins *et al.* (2003).

Enzyme use is well documented across different types of poultry diets. Example papers on amylase Ritz *et al.* (1995) and Jiang *et al.* (2008), protease Ghazi *et al.* (2002 and 2003) and Wang *et al.* (2008), xylanase Mathlouthi *et al.* (2002) and Cowieson (2005), beta-glucanase Mathlouthi *et al.* (2002), mixes of two or more of the aforementioned activities Pettersson and Åman (1992); Vranješ *et al.* (1994); Zanella *et al.* (1999); Hong *et al.* (2002); Mathlouthi *et al.* (2002); Meng *et al.* (2005) and Cowieson and Ravindran (2008a, b) as well as phytase Onyango *et al.* (2005) Liu *et al.* (2008a, b) are among the many that can be found in the Scientific literature. However, trials often examine one type of enzyme in isolation. For example, many of the published phytase papers do not examine relationships between phytase and various carbohydrases or proteases in practical diets. It would seem logical that combinations of phytase, nonstarch polysaccharidases NSPases or other activities may provide a benefit in practical diets.

Avian influenza viruses (AIV) are type A influenza viruses and belong to the Orthomyxoviridae family. They can be classified according to the antigenicity of its surface proteins haemagglutinin H and neuraminidase N.

Currently 16H (H1-16) and 9N (N1-9) subtypes have been described in avian species Fouchier *et al.* (2005). Furthermore the subtypes can be classified on the basis of their pathogenicity in chickens after intravenous inoculation. In Egypt, since early 2006, high pathogenicity avian influenza H5N1 has continued to spread in the domestic poultry farms despite the implementation of quarantine, improved biosecurity and vaccination Peyre *et al.* (2009) and World health organization (2010). The antibody responses upon AIV vaccination are generally higher in chickens than in other poultry species Higgins (1996). The majority of current AI vaccines have been inactivated whole-virus vaccines Swayne *et al.* (2003). As well, The insufficient efficacy of the current H5 vaccines to protect chickens against the newly emerging 2.2.1 variant highly pathogenic AI H5N1 strains in Egypt have been recently obtained Kim *et al.* (2010). Whilst, Brugh and Stone (1986) stated that vaccination of broilers would not be suitable, although research has shown great benefit to the day-old immunization of broilers with killed oil emulsion AI vaccine. Newcastle disease is caused by avian paramyxovirus type of the family Paramyxoviridae, whereas AI is caused by type A influenza virus of the family Orthomyxoviridae Alexander (2000) and Swayne and Suarez (2000). The highly virulent forms of ND and AI are on list A of the Office International des Epizooties Swayne and King (2003). Control of ND virus in poultry is mainly dependent on both live and inactivated virus vaccines Gallili and Ben-Nathan (1998).

The objective of the study is to examine the effects of Corn Distiller's Dried Grains with Solubles as partial replacement for yellow corn and soybean meal with or without Galzym addition (Enzyme Preparation) on growth performance, some blood plasma parameters, specific immunity against Avian Influenza Disease Virus (AIDV) and the Newcastle Disease virus (NDV).

MATERIALS AND METHODS

The present study was carried out at the Agriculture Research and Experiments Center; Faculty of Agriculture, Mansoura University, Egypt, during the period from September to October, 2012.

Birds and management:

Two hundred and forty one day-old of unsexed commercial-type Cobb 500 broiler chicks were used in this experiment from 10 to 45 days of age. The initial body weight of one day old chicks was about 49 g. They were randomly divided into six experimental treatments each of which was assigned to four replicates containing 10 chicks each. Chicks in all treatments were kept under similar conditions of management. Artificial lightning was provided 24 h daily during the whole experimental period. From post hatching to ten days-old, all chicks were fed a commercial starter ration containing 22 % crude protein and 3000 Kcal.ME/Kg diet then the chicks fed grower-finisher diets *ad Libitum* containing19 % crude protein and 3100 Kcal.ME/Kg.

Experimental design:

Chicks were allotted to the following dietary treatments in the starter and grower-finisher diets; T1: control diets, T 2: T1 + 0.05 % Galzym powder, T3: diets containing 10 % CDDGS, T4: T3 + 0.05 % Galzym powder, T5: diets containing 20 % CDDGS, T6: T5 + 0.05 % Galzym powder. The composition and calculated analysis of the experimental diets are shown in (Table1). CDDGS was provided by El -dakakahlia for poultry production company and Galzym powder was provided by Arab trade company (Tex Biosciences limited-India) each kilogram contained; Cellulase 100.000.000 U, Amylase 125.000 U, Arabinase 20.000 U, Pectinase 30.000 U, Protease 15.000 U, Lipase 10.000 U, Xylanase 1.500.000 U, α – Galactosidase 10.000 U, β – Glucosidase 10.000 U and Sodium Benzoate 50 mg. At the 10th day of age three chicks from each treatment were wing banded. Therefore, blood samples were taken from brachial vein of each chick before and after vaccination. Blood samples were collected in heparinized tubes, centrifuged immediately at 4000 r.p.m for 10 min. and plasma were decanted in Ependorfer tubes and frozen rapidly at -20ºc until the time of analysis.

Studied traits:

Final live body weight (LBW), total body weight gain (TBWG), total feed intake (TFI) and total feed conversion ratio (TFCR) were determined during the experimental period. Plasma total protein, cholesterol, triglycerides and inorganic phosphorus were determined by using commercial kits (BIO-ADWIC, Quimica clinging aplicada S.A., Human Gesellschaft fur Biochemica und Diagnostica GmbH Max-planck-Ring21-D-Wiesbaden-Germany, analyzed colorimetrically with a spectronic® 207) according to Doumas (1975), Allain *et al.* (1974), Sidney and Barnard (1973) and Using the AOAC (1984) procedure, respectively. The titer of HI against AIDV was determined by HI test according to Tian *et al.* (2005) and Kumar *et al.* (2007). HI titers log 2 to avian influenza using 4 HA units of H5N2 ift antigens. HI titers to Newcastle disease using 4HA units of Lasota Jovac NDV, Lasota strain propagated in embryonated chicken eggs.

Statistical analysis:

Data were statistically analyzed and computed using SAS (1990) by the application of the least square producer. Tests of significance for the differences among treatments means were done according to Duncan's multiple range test procedure Duncan (1955).

RESULTS AND DISCUSSION

Growth performance: The results showed that at 45th day of age there were significant increase ($P \leq 0.0001$) on final live body weight (LBW) due to different CDDGS levels as partial replacement, ($P \leq 0.01$) due to Galzym addition to diets as compared to control birds. Also, the highest final LBW values were recorded by the birds fed 20 % CDDGS followed by those fed Galzym addition then those fed 10 % CDDGS to diets as compared to control birds (Table2). These results are in agreement with Lumpkins *et al.* (2004) who found that 15% of DDGS improved the growth performance of broiler chicks from 0 to 18 days of age after feeding iso-caloric diets and no difference in growth performance from 0 to 42 days of age after feeding iso-caloric and iso-protein diets containing 12% DDGS. Likewise, Waldroup *et al.* (1981) showed that inclusion of 25 % DDGS into broiler diets with the ME content held constant could be used without reduction in body weight in which the energy content was allowed to decline as the level of DDGS was increased. Also, Wang *et al.* (2007a,b.c) suggested that good quality DDGS could be used in starter and grower broiler diets at levels of 15 to 20% CDDGS, with even higher levels of 30%CDDGS in the finisher diet. Although even higher levels of the new generation DDGS could be used in broiler diets without any negative impact on body weight. As well, Shurson (2003) observed that growth rate and survivability improved in broiler chicks when fed diets containing 10% DDGS from 14 to 38 days of age.

Table 1: Composition and calculated analysis of the starter and grower-finisher diets

ingredients	control		10 % CDDGS		20 % CDDGS	
	starter	Grower-finisher	starter	Grower-finisher	starter	Grower-finisher
Yellow corn	60	٦٨.٥	56	٦٣	52	٥٨
Soybean meal (44 %)	27.5	١٦.٧	19.5	١٣.٧	11	٨
Corn gluten meal (62%CP)	8.4	١٠.٧	10.2	٩	12	٩
CDDGS	0	٠	10	١٠	20	٢٠
Dicalcium phosphate	2	٢	2	٢	2.2	٢.٢
Limestone	1.2	١.٣	1.3	١.٣	1.5	١.٥
Common salt	0.3	٠.٣	0.3	٠.٣	0.3	٠.٣
Vit. & min. Premix*	0.3	٠.٣	0.3	٠.٣	0.3	٠.٣
DL- Methionine	0.1	٠.٠٥	0.1	٠.١٥	0.2	٠.٢
Lysine- HCL	0.2	٠.١٥	0.3	٠.٢٥	0.5	٠.٥
Total	100	١٠٠	100	١٠٠	100	١٠٠
Calculated analysis (air dry basis)						
ME; kcal/kg	٢٩٤٧	٣٠٧٢	٣٠٠٠	٣٠٦٠	٣٠٤٩	٣٠٧١
CP; %	٢٢.٦٥	١٩.٩٦	٢٢.٦٩	١٩.٩٧	٢٢.٦٦	١٩.٩٩
EE; %	٢.٧١	٣	٣.٦٥	٣.٨٤	٤.٥٨	٤.٧
CF; %	٣.٣٥	٢.٨٢	٣.٣٥	٣.٠٩	٣.٣٣	٣.٢١
Ca; %	١	١	١	٠.٩٩	١.٠٩	١.١
Available P; %	٠.٤٧	٠.٤٥	٠.٤٥	٠.٤٤	٠.٤٦	٠.٤٥
Lysine; %	١.١٤	٠.٨٥	١	٠.٨٢	٠.٩٤	٠.٨٥
Methionine; %	٠.٥	٠.٤٤	٠.٤٧	٠.٤٨	٠.٥٤	٠.٤٨
Meth. & cystine; %	٠.٨٩	٠.٧٩	٠.٨٢	٠.٧٩	٠.٨٤	٠.٧٤

*** Each 3 kg premix contains: Vit. A, 12.000.000 IU; Vit. D3, 2.500.000 IU; Vit. E, 10 g; Vit. K, 2.5 g; Vit. B2, 5 g; Vit. B6, 1.5 g; Vit. B12, 10 mg; Biotin, 50 mg; Folic acid, 1.0 g; Nicotinic acid, 30 mg; Pantothenic acid, 10 g; Antioxidant, 10 g; Mn, 60 g; Cu, 10 g; Zn, 55 g; Fe, 35 g; I, 1.0 g; Co, 250 mg and Se, 150 mg.**

Also, Day *et al.* (1972) and Couch *et al.* (1957) showed that DDGS have been used for broilers for many years, but very low level 5% of DDGS has been added in the broiler diet while the improvements in body growth rate and other characteristics were observed in early studies that incorporated DDGS to broiler and turkey diet. Likewise, Potter (1966) found that isonitrogenous broiler diets with 20 % DDGS supported performance equivalent to control diets when fed to broiler up to 8 weeks of age. Likewise, Choi *et al.* (2008) found that using of 5% CDDGS in broiler starter diet and up to 15% in grower diet had no negative impact on production parameters. Also, the results showed that there were insignificant effects (P > 0.05) on final LBW values of the interaction between CDDGS levels and Galzym addition to diets (Table2). Also, the highest final LBW values were recorded by the birds fed 20 % CDDGS with Galzym addition to diets as compared to other experimental birds.

These results are in agreement with those findings by Shalash *et al.* (2009) who found that adding preparation enzymes to CDDGS diets improved live body weight. Increased final live weight by addition of enzymes is agreed with many previous findings Richter *et al.* (1999); Augelovicova and Michalik (1997); Al-Bustany (1996) and Salobir *et al.* (1995) they concluded that improved feed utilization for exogenous enzyme was responsible for increased live body weight in broiler on similar level of dietary nutrient concentration. In turkeys, Noll and Brannon (2006) reported that birds fed 20% DDGS was not different in productive performance values compared with corn-soybean control. As well, Wyatt *et al.* (1997) and Pack *et al.* (1998) cited that supplementing corn based diets with enzymes produced significant positive responses to growth performance. However, the results showed that there were significant effects (P ≤ 0.0001) from 10^{th} to 45^{th} day of age, on total feed intake (TFI) values when using different CDDGS levels as partial replacement, (P ≤ 0.05) due to Galzym addition to diets as compared to control birds Table 2. The highest TFI values were recorded in the birds fed 20% CDDGS followed by those fed Galzym addition then those fed 10% CDDGS as compared to control birds. These results are in agreement with Onifade and Babatunde (1998) who reported increased feed intake with increasing levels of dietary Brewers Dried Grain (BDG). Likewise, Waldroup *et al.* (1981) who reported that inclusion 25 % of DDGS into broiler diets with the ME content held constant could be used without reduction in feed utilization. Also, Lumpkins *et al.* (2004), Wang *et al.* (2007), Choi *et al.* (2008) and Widyaratne and Zijlstra (2007) showed that dietary levels from 0 to 20% CDDGS had no significant effect on FI. On the contrary, Cromwell *et al.* (1993) concluded that chicks fed the darkest-colored, burnt-smelling DDGS resulted in decreased FI 13% as compared to chicks fed the lightest-colored DDGS. Also, there were insignificant differences (P > 0.05) on TFI values of the interaction between different levels of CDDGS and Galzym addition to diets (Table2). Also, the highest TFI values were recorded by the birds fed 20 % CDDGS with Galzym addition to diets as compared to other experimental birds. Also, the results showed that the highest total body weight gain (TBWG) values were recorded by the birds fed 20 % CDDGS followed by those fed Galzym addition then those fed 10 % CDDGS to diets as compared to control birds (Table2). However, there was insignificant effect (P > 0.05) on TBWG values of the interaction effect between the birds fed different levels of CDDGS and Galzym addition to diets (Table2). Also, the highest TBWG values were recorded in the birds fed 20 % CDDGS with Galzym addition to diets as compared to other dietary treatments.

These results are in agreement with Arce *et al.* (2010) who reported that adding protease and xylanase enzymes in broilers diets containing maize, soybean meal and DDGS yielded the best results in terms of broiler performance. As well, Parsons *et al.* (1983) found that DDGS can replace up to 40% soybean if lysine level in broiler diet can meet the requirement. Likewise, Shurson (2003) observed improved productive performance rate and survivability in broiler chicks when fed diets containing 10% DDGS from 14 to 38 days of age. On the other hand, Awad *et al.* (2011) indicated that TBWG values were insignificantly improved by feeding different CDDGS levels to diets compared with those birds fed control diet from 1 to 84 days in Domyati ducklings. Likewise, Wang *et al.* (2007a, b, c) found that higher levels of the new generation DDGS could be used in broiler diets without any negative effects on body weight. However, Lumpkins *et al.* (2004) and Choi *et al.* (2008) showed that more recently, the 'new generation' of CDDGS was utilized in poultry feed; incorporating 5% CDGS in broiler starter diets and up to 15% in grower diets had no negative effects on productive performance. Also, Lumpkins *et al.* (2004) focused on feeding inclusion rates of 0, 6, 12, and 18 % DDGS to young broiler chicks. They found that LBW and FI were not affected by feeding 12 % DDGS, but BWG and FI were reduced when broilers were fed 18% CDDGS, most likely due to an amino acid deficiency in the starter diet. Also, due to the high fiber content and low amino acid digestibility of DDGS, feeding high levels 25 to 30% of DDGS to starter broilers is not recommended. On the contrary, Waldroup *et al.* (1981) found that DDGS can be used at 25% level without any adverse effects on BWG as long as metabolizable energy level was consistent. However, Dale and Batal (2003) used 0, 6, 12 and 18% DDGS in broiler diets and reported that 12% DDGS resulted in a slight decrease in performance during the starter period while 18% DDGS had a negative impact on body weight. Also, Wang *et al.* (2008) found that at 14 days post hatch, the higher levels of DDGS numerically reduced the LBW at 35, 42 and 49 days, being reduced gradually more than 30% DDGS. They suggested that once beyond the starter and grower periods from 1 to 22 days, chicks could efficiently use not more than 20% DDGS into broiler rations. Also, Widyaratne and Zijlstra (2007) found that diets with 20% wheat DDGS had a decreasing trend on performance and suggested to use 15% wheat DDGS for broilers without negative effects on performance. Also, the obtained results showed that there were significant effects ($P \leq 0.0001$) during the experimental period on total feed conversion ratio (TFCR) values while there were insignificant differences ($P > 0.05$) due to Galzym addition to diets (Table2). Also, the best TFCR values were recorded by the birds fed 20% CDDGS followed by those fed diets with enzyme preparation as compared to control birds but the birds fed 10 % CDDGS recorded the highest TFCR values. The effect of interaction between CDDGS and Galzym addition levels was not significant on TFCR (Table2).

Table 2: Effects of CDDGS and Galzym levels on broiler productive performance from 10-45 days of age

Productive performance measurements		Final live body weight (g)	Total feed intake (g)	Total body weight gain (g)	Total feed conversion ratio
Age		45^{th} day	10 - 45 days	10 – 45 days	10 – 45 days
Main effect of CDDGS (A)					
Control(0%CDDGS)	1	2170^{c}	4839^{c}	2025^{c}	2.38^{b}
10 % CDDGS	2	2289^{b}	5120^{b}	2140^{b}	2.39^{b}
20% CDDGS	3	2524^{a}	5486^{a}	2368^{a}	2.32^{a}
SEM		0.01	0.03	0.01	0.004
Significance level		****	****	****	****
Main effect of Galzym (B)					
Control(0%Galzym)	1	2296^{b}	5107^{b}	2148^{b}	2.38
0.05%GALZYM	2	2357^{a}	5191^{a}	2207^{a}	2.35
SEM		0.01	0.02	0.01	0.003
Significance level		**	*	**	NS
A*B Interaction					
1 * 1		2158	4739	2012	2.٣٦
1 * 2		2185	4939	2040	2.٤٢
2 * 1		2261	5116	2113	2.٤٢
2 * 2		2318	5124	2168	2.٣٦
3 * 1		2474	5464	2320	2.36
3 * 2		2573	5508	2415	2.28
SEM		0.02	0.04	0.02	0.006
Significance level		NS	NS	NS	NS

(a-c) means with the same letter in each column in each category are not significantly different at p ≤ 0.05 NS = not significant at P > 0.05 * significant at p ≤ 0.05
**** significant at p ≤ 0.01 **** significant at p ≤ 0.0001**

These results are in agreement with Ghazalah *et al.* (2012) who showed that feeding broiler chicks on diets containing different levels of DDGS up to 60% as replacement for soybean meal with enzyme supplementation improved feed conversion values in laying hen diets. On the contrary, Wang *et al.* (2007a, b, c) formulated diets based on digestible amino acid levels and found that dietary inclusion up to 25% of CDDGS resulted in poorer FCR. Whilst, Amani *et al.* (2012) showed that BWG did not differ among diets containing 0, 10, 20 or 30% DDGS while FCR was significantly (P≤0.05) improved for rabbits fed10% and 20% CDDGS 1.97and 1.94 comparing to control one 2.09. As well, It is worthy to note that there was no mortality allover the experimental period; as broiler chicks fed diets containing different levels of DDGS. These results are in agreement with those findings by Youssef *et al.* (2008), Shalash *et al.* (2009) and Masadeh *et al*. (2010) who found that there was no mortality due to using DDGS in broiler chick diets. Likewise, More recently, the ‘new generation' of CDDGS was utilized in poultry feed; incorporating 5% CDGS in broiler starter diet and up to 15% in grower diet had no negative impact on production parameters found by Lumpkins *et al.* (2004) and Choi *et al.* (2008).

Some plasma constituents:

Total protein: There are significant differences among treatments ($P \leq 0.01$) in blood plasma total protein (TP) values (Table3). The birds fed basal diets and those fed 20% CDDGS recorded the highest values than those fed 10 % CDDGS into broiler rations. These results are in agreement with Kaya and Tarkan (2012) who found that the addition of DDGS in different amounts 5, 10 and 15% created statistically significant differences ($P<0.05$) between the total protein values in blood serum of broiler chicks. On the other hand, there were insignificant differences ($P > 0.05$) due to Galzym supplementation to diets (Table3). These results are in agreement with Qota *et al.* (2002); Shakmak (2003) and Al-Harthi (2006) who found that cell-wall degrading enzymes and/or phytase supplementation had no adverse effect on plasma biochemical constituents of broiler chicks. However, the obtained results of blood plasma total protein values were lower than those found by Lu and Chen (2005) but higher than those found by Kaya and Tarkan (2012).In ducks, Awad *et al.* (2011) found that plasma total protein values increased by feeding diets containing 30 % DDGS to Domyati ducklings. As well, Tanaka et al. (2008) reported that plasma total protein level was significantly increased after the commencement of DDGS feeding in lactating diary cows. Concerning the interaction effects, the present results showed that TP recorded the highest values in the birds fed 20% CDDGS with or without Galzym supplementation to diets. However, there were non significant differences ($P > 0.05$) in plasma TP values due to the interaction effects between CDDGS and Galzym levels (Table3). These results are in close agreement with those found by Lu and Chen (2005) who found that TP was not significantly affected by feeding diets contained 10 and 20 % DDGS to domestic colored broiler chickens. However, Bor-Ling *et al.* (2011) found that TP was not impacted by the dietary treatments 0, 6, 12 and 18% DDGS of laying hens. Likewise, Gabr *et al.* (2008) found that TP was not significantly affected by feeding diets contained 10, 15 and 20% DDGS to rabbits. On the contrary, Ghazalah *et al.* (2012) demonstrated that TP decreased when laying hens were fed diets contained 75 % DDGS.

2- Total cholesterol: The obtained results showed that there were significant differences ($P\leq 0.001$) in blood plasma total cholesterol due to different dietary treatments (Table3). While, the birds fed 20% CDDGS recorded the highest values than other experimental treatments. These results are in agreement with the findings by Bor-Ling *et al.* (2011) who found that plasma total cholesterol content was significantly increased when 12 % or 18 % DDGS diets were used for laying hens. However, the addition of Galzym increased significantly ($P\leq 0.001$) plasma total cholesterol levels. These results are in agreement with Mancini and Parillo (1991); Pettersson and Aman (1992) and Sutton *et al.* (1985) who found that plasma total cholesterol increased numerically according to enzymes supplementation to the diets. On the contrary, the results of the interaction effects between CDDGS and Galzym levels showed insignificant differences ($P > 0.05$) among all the experimental treatments (Table3). Also, Kaya and Tarkan (2012) indicated that the addition of different levels of DDGS did not affect plasma total cholesterol values in broiler chicks. Likewise, Shalash *et al.* (2009) reported that blood plasma total cholesterol content were not significantly affected by feeding diet contained 12 % DDGS in broiler chicks. However, the values of this study were lower than those found by Kaya and Tarkan (2012) and Bor-Ling *et al.* (2011). On the other hand, Awad *et. al.* (2011) found that plasma total cholesterol was decreased by 9.19, 18.10 and 20.76 % for the groups fed diet contained 10, 20 and 30% DDGS as compared to control, respectively in Domyati laying ducks. Also, Gabr *et al.* (2008) found that cholesterol was not significantly affected by feeding diets contained 10, 15 and 20% DDGS in rabbits diets. However, Gurung *et. al.* (2009) found that Serum cholesterol concentrations increased linearly (p<0.001) with increasing levels of DDGS in Spanish male goats. On the other hand, Jia *et. al.* (2009) found that addition of sorghum DDGS to the diets reduced plasma cholesterol in hamsters.

Table 3: Effects of dietary CDDGS and Galzym levels on broiler blood plasma parameters

Some Blood plasma parameters		Total Protein (g/dL)	Total Cholesterol (mg/dL)	Total Triglycerides (mg/dL)	Inorganic Phosphorus (mg/dL)
Main effect of CDDGS (A)					
control	1	4.25 ^{a}	٩٥.٥ ^{b}	٣٦.٨٣ ^{c}	٥.٢٧ ^{a}
10% CDDGS	2	3.99 ^{b}	٨٩.٠٨ ^{c}	٥٥.٩٢ ^{b}	٥.١٦ ^{a}
20% CDDGS	3	4.29 ^{a}	111.25 ^{a}	٦٥.٥ ^{a}	٤.٩٨ ^{b}
SEM		٠.٠٦	٠.٩	١.١	٠.٠٥
Significance level		**	***	***	**
Main effect of Galzym (B)					
control	1	٤.١٩٧	٩٢.٥ ^{b}	٤٨.٦ ^{b}	٥.١
0.05%GALZYM	2	٤.١٥٨	١٠٤.٧ ^{a}	٥٦.٨٩ ^{a}	٥.٢
SEM		٠.٠٥	٠.٧	٠.٩	٠.٠٤
Significance level		NS	***	***	NS
A*B Interaction					
1 * 1		٤.٠٣	٨٨.٥	٢٥.٣٣	٥.٤٧
1 * 2		٤.٤٦	١٠٢.٥	٤٨.٣٣	٥.٠٧
2 * 1		٤.٢١	٨٢	٥٤.١٧	٥.١٢
2 * 2		٣.٧٨	٩٦.١٦	٥٧.٦٧	٥.٢١
3 * 1		٤.٣٥	١٠٧	٦٦.٣٣	٤.٧٤
3 * 2		٤.٢٣	١١٥.٥	٦٤.٦٧	٥.٢٢
SEM		٠.٠٨	١.٣	١.٥	٠.٠٧
Significance level		***	NS	***	***

(a-c) means with the same letter in each column in each category are not significantly different at p ≤ 0.05 NS = not significant at P > 0.05 ** significant at p ≤ 0.01 * significant at p ≤ 0.001**

3- Total triglycerides: The obtained results showed that there were significant differences (P≤ 0.001) among treatments in blood plasma total triglycerides when using different CDDGS levels as partial replacement or Galzym addition to diets (Table3). Also, the interaction has significant effects on plasma total triglycerides (Table3). The highest mean of blood plasma total triglycerides values were recorded in the birds fed 20 % CDDGS with or without Galzym supplementation. On the contrary, Lu and Chen (2005) found that blood plasma triglyceride was not significantly influenced by the dietary CDDGS treatments. The obtained results were lower than those found by Kaya and Tarkan (2012) and Bor-Ling *et al.* (2011), but higher than those found by Lu and Chen (2005). Kaya and Tarkan (2012) demonstrated that blood plasma total triglycerides values were lower than control in broiler fed 5, 10 and 15 % DDGS. Also, Kaya and Tarkan (2012) indicated that plasma total triglycerides values were lower than the total triglycerides values found in the blood serum of ducks fed diets supplemented with 0, 6, 12 and 18% DDGS by Awad *et al.* (2011). However, Bor-Ling *et al.* (2011) found that plasma total triglyceride was not impacted by the dietary treatments 0, 6, 12 and 18 % DDGS in laying hens. Likewise, Lu and Chen (2005) found that the blood plasma triglyceride was not significantly influenced by the dietary treatments 10 or 20 % DDGS. On the contrary, Kimura (2005) found that the blood plasma triglycerides concentration clearly decreased after feeding DDGS.

4- Inorganic phosphorus: The results indicated that there were significant differences ($P \leq 0.01$) in plasma phosphorus level when using different CDDGS levels (Table3). Also, significant differences ($P \leq 0.001$) were recorded for the interaction between the different levels of CDDGS and Galzym supplementation to diets (Table3). These results showed that there were significant decrease in blood plasma inorganic phosphorus values in the birds fed 20% CCDDGS as compared to the control birds (Table3). These results are in agreement with Shalash *et al.* (2009) who reported significantly increase ($p<0.0001$) in plasma phosphorus values among the different treatments. Also, Martinez-Amezcua *et al.* (2004) noted a substantial variability in phosphorus bioavailability among nine samples, ranging from 69 to 102% relative to KH2PO4 and reported that increasing heat processing of DDGS may increase the bioavailability of phosphorus in DDGS. However, Leytem *et al.* (2008) found that the apparent retention of both nitrogen and phosphorus decreased linearly with increasing DDGS inclusion from 0 to 20% in the diets. They added that, at the greatest DDGS inclusion 20% rate there was a corresponding decrease in nitrogen digestibility by 19% and phosphorus digestibility by 23% compared with the control diet. However, the mean values of plasma inorganic phosphorus were lower than those found by Shalash *et al.* (2009) but higher than those obtained by Bor-Ling *et al.* (2011). Also, Viveros *et al.* (2002) found that Phytase supplementation to a low nonphytate phosphorus diets increased plasma phosphorus level. As well, Ali *et al.* (2006a) found that the addition of enzyme preparation to laying hen diet significantly increased plasma phosphorus level. Likewise, Heba (2011) found that plasma phosphorus concentrations increased with increasing DDGS inclusion level in cattle. On the other hand, there were non significant differences ($P > 0.05$) recorded by the effects of Galzym supplementation to diets. These results are in agreement with the findings of Qota *et al.* (2002); Shakmak (2003) and Al-Harthi (2006) who found that cell-wall degrading enzymes and/or phytase supplementation had no adverse effect on plasma biochemical constituents of broiler chicks.

Immunological traits:

-A- Specific immunity against avian influenza disease virus titer (AIDV): The obtained results showed that there were significant differences ($P \leq 0.001$) in immune response between treatments as compared to control birds

(Table4). These results showed that the highest AIDV titers were recorded for the birds fed 10 % CDDGS to diets followed by those fed 20 % CDDGS as compared to the control birds. On the other hand, there were no significant differences (P>0.05) due to adding Galzym addition to diets (Table4). Also, there were no significant differences (P>0.05) in the interaction between the different levels of CDDGS and Galzym supplementation to diets before and after vaccination (Table4). Also, the highest mean of AIDV titers were recorded by the birds fed 20 % CDDGS with Galzym addition to the diets. These results are in agreement with Shalash *et al.* (2009) who found that specific immunity against avian influenza disease virus of broilers were significant (p<0.01). The mean of AIDV titers values were higher than those found by Shalash *et al.* (2009). Also, El-Sayed *et al.* (2011) demonstrated that birds vaccinated with AI + ND recorded higher antibody titer against AI virus at all ages. Likewise, the obtained results revealed that HI titer values are in agreement with El-Sayed *et al.* (2011) who found that the geometric mean of HI titer against AI virus of experimental broiler chicks vaccinated with AI + ND vaccine was 8.20 log2 for all experimented ages. In agreement with these findings, Lebdah and Shahin (2010) who found that the geometric mean of HI titer of broiler chicks vaccinated at one day-old with H5N2 vaccine showed high titer. Likewise, Ellis *et al.,* (2004) stated that the use of killed H5N2 vaccine was able to protect chickens from disease and can reduce virus transmission. Also, these findings agreed with Tian *et al.* (2005).

However, Swayne *et al.* (2009) reported that the HI titers will probably be indicative of the level of protection and immunity to avian influenza. Also, Hafez *et al.* (2010) had shown that HI titer for commercial broiler chicks vaccinated at one day-old ranged from 5.2 to 9 log2 at 32 days-old and from 2.0 to 7.2 log2 at 45 days-old. However the HI titer for the chicks vaccinated at 7 days-old ranged from 2.0 to 3.0 log2 at 44 days-old.

-B- Specific immune response against Newcastle Disease virus (NDV): The obtained results revealed that there were no significant differences (P > 0.05) due to different CDDGS levels. Also, there were no significant differences (P > 0.05) for adding Galzym levels to diets. However, there were no significant differences (P > 0.05) in the interaction effects of using CDDGS levels with or without Galzym supplementation before and after vaccination time (Table4). These results are in agreement with El-Sayed *et al.* (2011) who found that there were no significant differences in antibody titer against ND virus of birds vaccinated with AI + ND vaccination program. In other words, birds vaccinated at one day-old recorded higher antibody titer against ND virus at 4 days of age (6.95 log2) than birds vaccinated at 7 days of age (6.50 log2). In reality, no physiological effect was detected, because both of them have titer of about 7 log2 which led to the same protection level 100% as indicted by Tian *et al.* (2005) and Kumar *et al.* (2007). On the other hand, the Newcastle disease virus HI titer values were lower than those obtained by El-sayed *et al.* (2011).

Table 4: Effects of dietary CDDGS and Galzym levels on some immunological traits (AIDV) titer and (NDV) titer (before and after vaccination) (log 2)

Immunological traits		AIDV	NDV
Main effect of CDDGS (A)			
control	1	٧.٣b	3.9
10% CDDGS	2	8.8 a	٣.٨
20% CDDGS	3	٨.٥a	٣.٨
SEM		0.3	0.1
Significance level		***	NS
Main effect of Galzym (B)			
control	1	٨.١	٣.٨٣
0.05 % Galzym	2	٨.٣	٣.٨٨
SEM		0.2	0.1
Significance level		NS	NS
Main effect of the time (C)			
Before		7.6 b	4
After		8.78 a	3.7
SEM		0.2	0.1
Significance level		***	NS
A * B * C Interaction			
1 * 1 * Before		6.3	4
1 * 1 * After		8.3	4
1 * 2 * Before		7.3	4
1 * 2 * After		7	3.7
2 * 1 * Before		8	4
2 * 1 * After		9	3.3
2 * 2 * Before		8.3	4
2 * 2 * After		10	4
3 * 1 * Before		7.3	4
3 * 1 * After		9.3	3.7
3 * 2 * Before		8.3	4
3 * 2 * After		9	3.7
SEM		0.5	0.25
Significance level		NS	NS

(a-b) means with the same letter in each column in each category are not significantly different at p ≤ 0.05 NS = not significant at P > 0.05 * significant at p ≤ 0.001**

Conclusion

It is concluded that supplementing broiler’s diets with 20 % CDDGS with or without Galzym supplementation improved growth performance and blood plasma total protein values but decreased inorganic phosphorus values and insignificantly increased blood plasma total cholesterol as compared to the control samples. The use of CDDGS levels as partial replacement with or without Galzym preparation to broiler diets enhanced the specific immunity against avian influenza disease virus (AIDV) titer values. As well, there were no negative effects on NDV titer values.

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تأثير استخدام نواتج تقطير حبوب الأذرة المجففة بالمذيبات مع أو بدون إضافة مسحوق الجالزيم في علائق بداري التسمين علي الأداء الإنتاجي وبعض القياسات الفسيولوجية

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قد أجريت هذه الدراسة لمعرفة مدى تأثير استخدام مستويات 10٪و 20٪ CDDGS (ناتج تقطير حبوب الأذرة المجففة بالمذيبات) كبديل جزئي عن الأذرة الصفراء وكسب فول الصويا بدون أو مع إضافة 0.05٪ من مسحوق المستحضر الإنزيمي (جالزيم) على الأداء الإنتاجي ، بعض قياسات بلازما الدم وكذلك الاستجابة المناعية لكتاكيت التسمين. تم توزيع ٢٤٠ كتكوت تسمين عمر يوم -غير مجنسين- من سلالة Cobb 500 عشوائيا إلي ٦ معاملات تجريبية كل معاملة تحتوي علي ٤٠ كتكوت تسمين. تم تغذية طيور المعاملة الأولي(م١) علي علائق بادئ ونامي- ناهي بدون أي إضافات وهي عليقة المقارنة ؛ تم تغذية طيور المعاملة الثانية (م٢) علي نفس علائق المعاملة الأولي مضافا إليها ٠.٠٥ % من المستحضر الإنزيمي ؛ تم تغذية طيور المعاملة الثالثة (م٣) علي علائق المعاملة الثالثة مضافا إليها ٠.٠٥ % من المستحضر الإنزيمي ؛ تم تغذية طيور المعاملة الخامسة (م٥) علي علائق تجريبية تحتوي علي ٢٠ % CDDGS ؛ كذلك تم تغذية طيور المعاملة السادسة (م٦) علي نفس علائق المعاملة الخامسة مضافا إليها ٠.٠٥ % من المستحضر الإنزيمي.

وقد أظهرت النتائج زيادة وزن الجسم الحي عند التسويق (عمر ٤٥ يوم) باستخدام CDDGS كبديل جزئي في علائق التسمين. وقد سجلت الطيور المغذاة علي علائق تحتوي علي ٢٠% CDDGS مضافا إليها ٠.٠٥ % من المستحضر الإنزيمي أعلي القيم لوزن الجسم الحي وإجمالي العلف المستهلك خلال الفترة التجريبية مقارنة بباقي طيور المعاملات الأخرى. أيضا قد سجلت أقل القيم في معدل التحويل الغذائي مقارنة بباقي طيور المعاملات الأخرى. أظهرت النتائج المتحصل عليها وجود زيادة معنوية في المعاملات التجريبية في كل محتوي البلازما من البروتين الكلي والجلسريدات الثلاثية الكلية مقارنة بالمعاملة الكنترول. كما لوحظ زيادة غير معنوية في محتوي البلازما من الكولستيرول مقارنة بمجموعة الكنترول. وأيضا لوحظ وجود انخفاض معنوي في محتوي البلازما من الفوسفور الغير عضوي مقارنة بالكنترول. كما ارتفعت قيم تتر المناعة التخصصية ضد مرض أنفلونزا الطيور الفيروسي بشكل معنوي في الطيور التي تغذت علي علائق تحتوي علي ١٠ % كبديل جزئي مع إضافة ٠.٠٥ % من المستحضر الإنزيمي مقارنة بالمعاملات التجريبية الأخرى. وكذلك لم يلاحظ تأثيرات معنوية علي قيم المناعة التخصصية ضد مرض النيوكاسل الفيروسي بعد التحصين بين جميع المعاملات التجريبية.

وبناء علي النتائج المتحصل عليها يمكن استنتاج أنه عند تغذية كتاكيت اللحم علي علائق تحتوي حتى ٢٠ % CDDGS كبديل جزئي للأذرة الصفراء وكسب فول الصويا مع أو بدون إضافة ٠.٠٥ % من المستحضر الإنزيمي (جالزيم) أدت إلي تحسين الأداء الإنتاجي للطيور كما أدت لزيادة قيم المناعة التخصصية ضد مرض أنفلونزا الطيور الفيروسي ولم تؤثر سلبيا علي القياسات الفسيولوجية للدم.

قام بتحكيم البحث

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