

## **USING XYLANASE, FRESH OR WHEY POWDER ALONE OR IN COMBINATION FOR IMPROVING LOW ENERGY BROILER DIET CONTAINING WHEAT BRAN**

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### **SUMMARY**

**T**he aim of this study is examine the ability of xylanase (XY), fresh whey (FW), dried whey (DW) alone or in combination to improve broiler low energy diet containing 30% wheat bran (WB). This experiment conducted in Egypt from April to May (23.9 °C-34.8°C). Two hundred and ten unsexed Cobb broiler chicks seven days old were randomly distributed into seven treatments received control diet, WB (30%) diet, WB+0.1%XY, WB+1% FW, WB+ 0.5% DW, WB+ XY +1% FW or WB+ XY + 0.5 % DW. At 35 days. Birds fed WB diet recorded significantly higher body weight by 2.43% compared to control diet. The birds fed WB +XY was significantly higher in body weight compared to all treatments. Dried whey failed in affecting performance of WB diet. Addition of XY to WB diet significantly increased carcass percentage compared to WB diet or control diet. Wheat bran diet alone increased plasma globulin and phosphorus by 114.8 and 48.54 %, respectively compared to control diet. Xylanase is a suitable additive for WB diet. It could be concluded that the diets containing 30 % wheat bran low energy diet alone or with 0.1% Xylanase improve broiler performance under condition of this study.

**Keywords:** *wheat brain, xylanase, fresh whey, dried whey, low energy diet, broiler.*

### **INTRODUCTION**

Recently, the interest in dietary fiber increased as a way to reduce poultry diet costs because of high prices of energy sources (corn and oil). The most important source of energy is cereals which contain mainly terpenoids, glycosides, alkaloids, phenols and polysaccharides (Wills *et al.*, 2000). Wheat bran (WB) is agro-industrial derived byproducts which arise during starch and flour production and are associated with high dietary fiber content. Cell walls of monocotyledons contain mainly cellulose, hemicelluloses and pectin. It is well known that they contain numerous hydroxycinnamic acids mainly covalently bound to polysaccharides via ester linkages low energy diet (2500 k cal) Gallardo *et al.* (2006). For example, ferulic acid, which is the major phenolic acid of WB, is mainly ester-linked with arabinoxylan which comprises 30 percent dried WB mass (Maes and Delcour, 2002). Kang *et al.* (2016) found that WB enzymatically processed, which showed high amount of soluble arabinoxylan, as an anti-inflammatory effect. In addition, antioxidant phenolics such as ferulic, vanillic, and p-coumaric acids contained in wheat are present mostly in the bran portion of the grain (Onyeneho and Hettiarachchy, 1992). Also, Wheat bran derived arabinoxylan augmented antibody response against avian Eimeria infection in chickens (Akhtar *et al.*, 2012). Feruloyl oligosaccharides can be released from WB either by mild acid hydrolysis or by treatment with a mixture of polysaccharide hydrolyzing enzymes, such as fungal hydrolyses (Wang *et al.*, 2010).

Courtin *et al.* (2008) showed that WB digestion with xylanase (XY) released oligo-saccharides which improved FCR of maize-fed birds to the same extent as the inclusion of the same XY in the ration. Nian *et al.* (2011) investigated that XY might increase more than 25% of the net energy for production in broilers by reducing energy for heat production. The likely interpretation for such a reduction in heat production is that the dietary fiber often contributes to a significant amount of heat production after ingestion. Whey is a by-product of cheese making and is characterized by its high water content, its nutritive value, and its high concentrations of lactose and sodium (Shariatmadari and Forbes, 2005). Ali (2002) found that broiler diet contained 30% WB supplemented with Radish extract (as a source of peroxidases enzyme) improved performance and digestibility of all nutrients. Also, Abaza *et al.* (2004)

found with local hen diets containing 35% WB that addition of enzyme preparation, or enzyme preparation plus Radish extract improved FCR, egg weight and egg mass. Dajanta *et al.*(2008) reported that lactoperoxidase is a major enzyme in whey that could play an important part of the natural host defense system in mammals and provided protection against invading microorganisms. Dried whey (DW) is a concentrated by-product of cheese processing and a rich source of lactose (80%). Gulsen *et al.* (2002) reported that broiler diet supplemented with lactose and DW improved growth in broilers. Also, Ali *et al.* (2016) found that the addition of DW significantly increased BW at 35 day by 6.9% compared to control. Ali *et al.*(2008) mentioned that 30% WB can be incorporate into broiler diets without adverse effect on performance and it has a beneficial effect on plasma antioxidant capacity, phosphorus and globulin.

The aim of this study is examine the ability of xylanase, fresh whey, dried whey alone or in combination to improve wheat bran diluted broiler diet.

## MATERIALS AND METHODS

The experimental work was carried out at EL- Fayoum poultry farm, Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Egypt. This experiment conducted in Egypt from April to May (23.9 C-34.8 C)

**Experimental birds and design:** Two hundred and ten unsexed Cobb broiler chicks seven days old were randomly distributed into seven treatments. Each treatment comprised of 30 birds which were divided into 3 replicates of 10 chicks each. Commercial xylnase Natugrain® wheat TS (XY) was provided by BASF Germany. Natugrain® Wheat TS (XY) is a preparation of endo-1,4-beta-xylanase (xylanase) produced by a genetically modified strain of *Aspergillus niger*. The dried whey (DW) was purchased from local market in Cairo. The fresh whey was provided by milk producer unit, Animal Production Research Institute. Seven dietary treatments were made using a control and WB diet (Table 1).

- 1-Basal diet (control).
- 2- Basal diet containing 30% wheat bran (WB).
- 3- WB diet + 0.1% xylanase (XY).
- 4- WB diet + 1% fresh whey(FW).
- 5- WB diet + 0.5% dried whey (DW).
- 6- WB diet + 0.1% XY +1% FW.
- 7- WB diet + 0.1% XY + 0.5% DW.

Control diets were formulated (Table1) starter-grower (1- 28d) and finisher (29-35d) periods. All birds received feed and water ad-libitum. Body weights (BW), feed consumption (FC) were recorded weekly and average body weight gains (BWG) and feed conversion ratio (FCR) were calculated while, mortality was recorded at once.

**Slaughter test:** At the end of the experiment period (35 days of age), 3 birds from each treatment were randomly taken and slaughtered to evaluate carcass characteristics and determine blood constituents. The carcass and giblets (gizzard, liver and heart) were separately weighed in addition to spleen and abdominal fat. Blood samples were taken to determine plasma content of total protein, Albumin, Globulin, Total lipids, Cholesterol, Phosphorus, antioxidant activity using commercial kits produced by Biodiagnostic Company, Egypt.

**Haematology analyses:** Erythrocyte (RBC),differential white blood counts (heterophils, lymphocytes and monocytes), haemoglobin concentration (Hb), cell haemoglobin (MCH), corpuscular volume (MCV) and corpuscular haemoglobin concentration (MCHC) were determined as described by Benson *et al.* (1989), Lamb (1981) and Jain (1986).

The obtained data were statistically analyzed using linear models procedure described in SAS users guide (SAS, 2004). Differences among means were tested using Duncan's multiple range test (Duncan's, 1955).

## RESULTS AND DISSCUSION

### **Growth Performance:**

The effect of dietary treatments on live body weight (BW) and body weight gain (BWG) is shown in Table (2). At 14 days there were significant differences in live BW between different treatments with

inconsistent trend. At 28 day significant differences were detected in BW by using different treatments, the best BW obtained by those chicks fed on WB+XY followed by control and WB+XY+FW without significant difference between them. Addition of XY to WB diet increased BW by 3.26% compared to chicks fed WB diet alone and recorded the same body weight of control group (1201 vs 1198g). At 35 day, WB+XY diet recorded the highest value while WB+ XY+DW recorded the lowest value. It was surprise that birds fed WB alone recorded superior BW compared to birds fed control diet at 35 day, since the WB diet contain lower metabolizable energy compared to control diet (Table1). Abaza *et al.*(2004) suggested that AME value of wheat bran is higher than that presented in NRC (1994) and indicated that classical method of determined the AME value for wheat bran alone is different from when it fed with other nutrients like salt, vitamin, source of protein...etc. Also, Nadeem *et al.* (2005) found that AME for

**Table (1): Composition and calculated analysis of Starter-grower and Finisher diets.**

Ingredients %	Control		Wheat bran 30%	
	Starter-grower 1-28 d	Finisher 29-35 d	Starter-grower 1-28 d	Finisher 29-35 d
Wheat bran	-----	-----	30.00	30.00
Yellow corn	57.88	62.05	34.05	38.22
Soybean meal 44%	29.79	26.25	23.79	20.25
Corn Gluten meal 60%	5.00	4.00	5.00	4.00
Soya bean oil	3.29	4.26	3.29	4.26
Di calcium phosphate	1.70	1.46	1.35	1.10
Limestone	1.12	0.99	1.25	1.15
Salt	0.50	0.40	0.50	0.38
Premix*	0.30	0.30	0.30	0.30
D l –methionine	0.18	0.16	0.18	0.16
L. lysine	0.24	0.13	0.29	0.18
Total	100	100	100	100
Calculated analysis %: **				
Crude protein	21	19	21.06	19.09
ME(kcal/kg)	3080	3176	2538	2638
Calcium	0.89	0.78	0.88	0.78
Available phosphorus	0.45	0.41	0.46	0.41
Lysine	1.25	1.06	1.25	1.06
Methionine	0.57	0.52	0.56	0.51
Methionine &Cystine	0.91	0.83	0.94	0.86
Sodium	0.21	0.17	0.22	0.17

\* Each 3 kg contain: Vit A12 000 000 OIU, Vit D<sub>3</sub> 2 000 000IU, Vit E 10g, Vit K<sub>3</sub> 2g, Vit B<sub>1</sub> 1g, Vit B<sub>2</sub> 5g, Vit B<sub>6</sub> 1.5g, Vit B<sub>12</sub> 10mg , Nicotinic acid 30g, Pantothenic acid 10g, Folic acid 1g, Biotin 50mg Choline chloride 250g, Iron 30g, Copper 10g, Zinc 50g, Manganese 60g, Iodine 1g, Selenium 0.1g, Cobalt 0.1g and carrier (CaCO<sub>3</sub>) to 3 kg.

\*\*According to Feed Composition Tables for animal and poultry feedstuffs used in Egypt (2001).

wheat bran were noted 1840 Kcal/kg which higher compared to that reported by NRC(1994). In this respect, Andersen *et al.* (1988) reported that bonds in wheat bran are hydrolysed almost instantaneously on contrast with the acidic (pH-2.5) stomach contents of humans. These results agree with Ibrahim *et al.* (2005) who conducted two experiments with broiler diets containing 30% WB and found in one of them that birds fed WB diet recorded higher BWG than broiler fed control diet and indicated that phytase content in WB may increase mineral and protein availability and consequently increased gain at 7 week age over the control diet. In this respect, Cavalcanti and Behnke (2004) showed that WB can be utilized as a viable source of phytases. These results agree with those reported by Ali *et al.* (2008) who found that 30% WB can be incorporate into broiler diets without adverse effect on performance. Hedge *et al.* (1978) revealed that a diet containing wheat bran gave better results in growth than the control diet. Also, Growth promoting effects of wheat bran in poultry diet as feed supplement had also been reported by some workers (Darwazeh, 2010 and Leeson and Summers, 2008) which support the findings of the current study. Wheat bran contained many valuable constituents like a large amount of betaine (1505.6 mg/100 g) as recorded by Zeisel *et al.* (2003) while the betaine in maize and soybean meal were reported to be below the detectable level (Chendrimada *et al.*, 2002).

**Table (2). Effect of low energy diet supplemented with xylanase, fresh and dried whey on live body weight and body weight gain**

Treatment	Live body weight(g)				Body weight gain(g)			
	7d	14d	28d	35d	7-14d	15-28d	29-35d	7-35d
Control	122.25	329.73 <sup>a</sup>	1198.50 <sup>a</sup>	1721.82 <sup>de</sup>	207.48 <sup>a</sup>	868.77 <sup>ab</sup>	523.32 <sup>c</sup>	1599.57 <sup>de</sup>
WB	122.77	317.43 <sup>ab</sup>	1163.67 <sup>b</sup>	1763.67 <sup>bc</sup>	194.67 <sup>ab</sup>	846.23 <sup>bc</sup>	600.00 <sup>ab</sup>	1640.90 <sup>bc</sup>
WB+ XY	122.90	325.25 <sup>a</sup>	1201.67 <sup>a</sup>	1808.87 <sup>a</sup>	202.35 <sup>a</sup>	876.42 <sup>a</sup>	607.20 <sup>a</sup>	1685.97 <sup>a</sup>
WB + FW	122.70	310.13 <sup>ab</sup>	1166.75 <sup>b</sup>	1742.43 <sup>cd</sup>	187.43 <sup>ab</sup>	856.62 <sup>ab</sup>	575.68 <sup>ab</sup>	1619.73 <sup>dc</sup>
WB + DW	122.67	300.17 <sup>b</sup>	1129.33 <sup>c</sup>	1690.83 <sup>e</sup>	177.50 <sup>b</sup>	829.17 <sup>c</sup>	561.50 <sup>bc</sup>	1568.17 <sup>e</sup>
WB+ XY+FW	122.81	330.33 <sup>a</sup>	1187.00 <sup>a</sup>	1782.50 <sup>ab</sup>	207.52 <sup>a</sup>	856.67 <sup>ab</sup>	595.50 <sup>ab</sup>	1659.68 <sup>ab</sup>
WB+ XY+DW	122.97	311.67 <sup>ab</sup>	1107.83 <sup>d</sup>	1688.33 <sup>e</sup>	188.80 <sup>ab</sup>	796.17 <sup>d</sup>	580.50 <sup>ab</sup>	1565.37 <sup>e</sup>
SEM	±5.433	±6.49	±5.64	±10.75	±6.41	±7.01	±13.51	±10.88

No. of birds = 30, *a,b,c,d,e* Means in the same column with different superscripts are significantly different ( $P<0.05$ ).  
WB= Wheat bran, XY=Xylanase, FW=fresh whey, DW=dried whey

In this setting, antioxidant properties of betaine decreased tissue damage arising from lipid peroxidation in heat stress of broilers (Attia *et al.*, 2009). Also, Betaine protects chick intestinal cells from coccidian infection, alleviate symptoms and improves performance (Fetterer *et al.*, 2003 and Kettunen *et al.*, 2001). The betaine content in WB diet may be the reason of higher its BW compared to control diet. The WB diet contains several antioxidants which may increase the birds growth. For example, antioxidant phenolic such as ferulic, vanillic and p-coumaric acids contained in wheat are present mostly in the bran portion of the grain (Onyeneho and Hettiarachchy, 1992).

The WB diet may be promised diet in the future to fight poultry diseases by its antioxidants phenolic compounds. In this connection, oxidative stress due to the accumulation of reactive oxygen species is thought to be the key pathogenesis for many neurodegenerative diseases due to the attacking and damaging of cellular constituents, such as DNA, proteins, carbohydrate, nucleic acid and lipoprotein, leading to cell death and tissue injure (Rushmore *et al.*, 1991). On the other hand, the WB diet contains higher fiber compared to control diet and this may increase the retention time in digestive tract. In this respect, greater development of the broiler gastrointestinal tract suggests that feed may be retained in the upper digestive tract for a longer period allowing for increased enzymatic digestion (Jones and Taylor, 2001). However, Whole grain feeding has been associated with increased gut development and health, that is a heavier muscular gizzard and less occurrence of periventricular dilatation (Jones and Taylor, 2001). At 35 days, the birds fed WB +XY recorded of higher BW by 2.56 % and 5.56% compared to birds fed either WB or control diets respectively. The beneficial effect of XY on WB diet can be explained on the basis that XY liberate the nutrients and antioxidants from fiber matrix and birds can utilize it. Moreover, the non-starch polysaccharide hydrolysis products may serve as prebiotics (Bedford, 2000) and indirectly prohibit the growth of certain pathogenic species including *Clostridium perfringens* (Engberg *et al.*, 2004). In this respect; Feruloyl oligosaccharides can be released from WB either by mild acid hydrolysis or by treatment with a mixture of polysaccharide hydrolyzing enzymes, such as fungal hydrolyses (Wang *et al.*, 2010). Kang *et al.* (2016) found that enzymatically processed wheat bran, which showed a comparatively high amount of soluble arabinoxylan, has an anti-inflammatory effect. Courtin *et al.* (2008) showed that WB digestion with XY released oligosaccharides which improved FCR of birds fed maize to the same extent as the inclusion of the same XY in the ration. Van der Klis *et al.* (1995) found a significant positive influence of endoxylanase supplementation to wheat-based diets on the absorption of calcium, magnesium, sodium and potassium in broilers, but there was no effect on phosphorus absorption. Also, xylanase may decrease the heat production of WB diet. Nian *et al.* (2011) investigated that XY might increase more than 25% of the net energy for production in broilers by reducing energy for heat production. The likely interpretation for such a reduction in heat production is that the dietary fiber often contributes to a significant amount of heat production after ingestion.

On the other hand, xylanase may reducing the bacterial population and decrease digesta passage. In this regard, exogenic enzymes such as xylanase added to wheat based feed can reduce digesta viscosity, increase the digesta passage rate, and improve nutrient digestion and absorption, thereby reducing the bacterial population in the small intestine (Bedford & Apajalahti, 2001). From previous discussion, we can indicate that the valuable nutrients and antioxidants presence in WB are the main reason to overcome the lower energy in WB diet.

The beneficial effect of antioxidants and valuable nutrients are not only important for improving the utilization of low energy diet but also for improving performance in hot temperature. The addition of FW

to WB diet did not affect body weight. Addition of DW to WB significantly decreased BW compared to WB diet alone at 28 and 35 day. These results disagree with those obtained by Ali *et al.* (2016) and Marwa (2013) who found that the addition of DW significantly increased BW at 35 day compared to control group.

The data in Table (2) indicated that DW is not suitable additive to WB diet. On the other hand, these results agree with Bilgili and Moran (1990) who indicated that the inclusion of dried whey in the diet did not improve performance parameters in broilers. Also, Samli *et al.* (2007) found that dried whey did not contribute any additional improvement in bird performance when added to the chick diet in combination with the probiotic. The addition of both XY plus FW numerically increased BW compared to birds fed WB diet alone. Addition of both XY plus DW decreased BW significantly compared to birds fed WB diet alone. The same trend of BW with dietary treatments was observed in BWG (Table 2) in starter-grower, finisher and over all period.

There were significant differences between feed consumption values (Table 3) in starter, finisher and over all period. Also, there were significant differences between feed conversion recorded by birds fed different treatments in starter, grower, finisher and all over periods (Table 3). In grower period, the birds fed WB diet plus XY recorded the best value of FCR (1.63) while, birds fed WB plus XY+DW recorded the worst value (1.75). It was found that in finisher period, birds fed control diet recorded the worst feed conversion values while birds fed WB alone recorded the best values (1.56). The relatively higher temperature in this study may affect FCR in birds fed control diet while antioxidants and betaine in WB diet protect the birds from free radical.

**Table (3). Effect of low energy diet supplemented with xylanase, fresh and dried whey on feed consumption and feed conversion ratio.**

Treatment	Feed consumption(g)				Feed conversion ratio(g feed/g gain)			
	1-14d	15-28d	29-35d	7-35d	FCR 1	FCR2	FCR3	OFCR
Control	336.80 <sup>a</sup>	1433.42	906.17 <sup>c</sup>	2676.38 <sup>ab</sup>	1.62 <sup>a</sup>	1.65 <sup>c</sup>	1.73 <sup>a</sup>	1.67 <sup>a</sup>
WB	285.45 <sup>b</sup>	1426.91	934.37 <sup>b</sup>	2646.73 <sup>ab</sup>	1.47 <sup>ab</sup>	1.69 <sup>bc</sup>	1.56 <sup>c</sup>	1.62 <sup>bc</sup>
WB+ XY	279.15 <sup>b</sup>	1424.20	994.96 <sup>a</sup>	2698.32 <sup>a</sup>	1.38 <sup>b</sup>	1.63 <sup>c</sup>	1.64 <sup>abc</sup>	1.60 <sup>c</sup>
WB + FW	282.61 <sup>b</sup>	1430.46	903.38 <sup>c</sup>	2616.45 <sup>ab</sup>	1.51 <sup>ab</sup>	1.67 <sup>bc</sup>	1.57 <sup>bc</sup>	1.62 <sup>bc</sup>
WB + DW	259.65 <sup>b</sup>	1430.00	946.08 <sup>b</sup>	2635.73 <sup>ab</sup>	1.46 <sup>ab</sup>	1.72 <sup>ab</sup>	1.69 <sup>ab</sup>	1.68 <sup>a</sup>
WB+ XY+ FW	275.10 <sup>b</sup>	1420.67	952.35 <sup>b</sup>	2648.12 <sup>ab</sup>	1.33 <sup>b</sup>	1.66 <sup>c</sup>	1.60 <sup>bc</sup>	1.60 <sup>c</sup>
WB+ XY+ DW	251.01 <sup>b</sup>	1395.09	954.87 <sup>b</sup>	2600.96 <sup>b</sup>	1.34 <sup>b</sup>	1.75 <sup>a</sup>	1.65 <sup>abc</sup>	1.66 <sup>ab</sup>
SEM	±11.23	±12.52	±8.87	±24.73	±0.06	±0.019	±0.037	±0.016

*a,b,c Means in the same column with different superscripts are significantly different (P<0.05).*

*WB= Wheat bran, XY=Xylanase, FW=fresh whey, DW=dried whey.*

These results agreed with those obtained by Ali *et al.*(2008) who found that birds fed WB alone recorded the best value of finisher FCR and indicated that birds may need nature antioxidants presence in WB diet to increase capacity of detoxification of free radical and consequently improved FCR. In this respect, Ferulic, a major phenolic acids found in cereals, is well known for its ability to scavenge free radicals (Shahidi *et. al*, 1992). On the other hand, the relatively higher temperature in this study may decrease energy for maintenance and consequently improved FCR. Virk *et al.* (1976) found that that FCR was better in summer than in winter seasons. In all over period, the birds fed WB diet plus XY or XY+FW recorded the best FCR. The beneficial of XY on FCR may be due to its effect on bacterial numbers. Bedford and Apajalahti (2001) demonstrated in birds fed wheat-based diets that addition of a xylanase-based enzyme preparation resulted in a 60% reduction in bacterial numbers. Wheat bran contain arabinoxylan which affect FCR by several mechanisms. For example, it has been reported that chickens of arabinoxylan administered groups were active with improved feed conversion efficiency which might be due to the fact that WB arabinoxylan used as a fermentable substrate enhanced the growth of non-pathogenic, facultative anaerobes and gram positive bacteria forming lactic acid and hydrogen peroxide, suppression of the growth of enteric pathogens and enhancement of digestion and utilization of nutrients (Brisbin *et al.*,2008 and Kabir, 2008). We can concluded that under condition of this study, antioxidants and valuable nutrients in WB diet are important for overcome the lower energy content and improving performance in hot temperature, XY is suitable additive for WB diet and supplementation of DW failed to improve the utilization of WB diet.

**Carcass characteristics:**

The effect of dietary treatments on carcass characteristics is shown in Table (4). The birds fed WB diet alone recorded the lowest values while birds fed WB + FW or WB+DW and WB+ XY recorded the highest values. There were significant differences in liver weight percentage. The birds fed WB diet recorded the highest values while birds fed WB+ DW and WB+XY recorded the lowest values.

**Table (4). Effect of low energy diet supplemented with xylanase, fresh and dried whey on some of carcass characteristics at 5 weeks**

Treatment	Carcass%	liver%	Heart%	Gizzard%	Spleen%	Abdominal fat%
Control	68.20 <sup>b</sup>	2.08 <sup>ab</sup>	0.55	1.38 <sup>b</sup>	0.127 <sup>bc</sup>	1.18 <sup>a</sup>
WB	67.84 <sup>b</sup>	2.52 <sup>a</sup>	0.48	2.13 <sup>a</sup>	0.152 <sup>a</sup>	1.24 <sup>a</sup>
WB+ XY	70.18 <sup>a</sup>	1.94 <sup>b</sup>	0.52	2.00 <sup>a</sup>	0.127 <sup>bc</sup>	0.63 <sup>c</sup>
WB + FW	70.30 <sup>a</sup>	2.27 <sup>ab</sup>	0.53	2.04 <sup>a</sup>	0.110 <sup>c</sup>	0.68 <sup>c</sup>
WB + DW	70.25 <sup>a</sup>	1.90 <sup>b</sup>	0.54	2.03 <sup>a</sup>	0.142 <sup>ab</sup>	0.90 <sup>b</sup>
WB+ XY+ FW	68.09 <sup>b</sup>	2.11 <sup>ab</sup>	0.46	1.80 <sup>a</sup>	0.115 <sup>c</sup>	1.14 <sup>a</sup>
WB+ XY+ DW	69.09 <sup>ab</sup>	2.08 <sup>ab</sup>	0.50	1.93 <sup>a</sup>	0.123 <sup>bc</sup>	1.11 <sup>a</sup>
SEM	±0.618	±0.170	±0.034	±0.106	±0.007	±0.061

*a,b,c Means in the same column with different superscripts are significantly different (P<0.05).*

The birds fed control diet recorded the significant lowest value of gizzard % compared to other treatments. Also, significant differences were detected between values of spleen weight percentage, the birds fed WB alone significantly increased spleen % compared to control.

The statically analysis indicated that abdominal fat percentage were significantly decreased in WB+XY and WB+FW diet compared to other treatments. While, no significant differences were observed between control and WB. However, Ali (2002) found that WB diet without or with additives numerically decreased the abdominal fat percentage.

**Plasma parameters**

The effect of dietary treatments on plasma parameters is shown in Table (5). It was found that the differences between values of plasma total cholesterol were significant. The birds fed control diet and WB +XY+ DW recorded the highest values while birds fed WB+DW and WB+FW recorded the lowest values. Ali *et al.* (2008) found that birds fed WB-diet alone or with feed additive recorded significantly lower cholesterol than those fed the control diet. The addition of XY to WB had no better affect on plasma cholesterol. Data in Table (5) showed that birds fed WB+XY+FW recorded the highest value of plasma total protein compared to other treatments. Also, significant differences were observed between albumin and globulin values recorded by different treatment. The birds fed WB diet alone or WB+XY recorded higher value of plasma globulin by 114.8% and 118.5, respectively, compared to control diet. All treatments were superior of globulin compared to birds fed control diet meaning that WB diet alone or with additive improved the immune status. These results agree with those obtained by Ali *et al.*(2008) who found that WB-diet increased value of plasma globulin by 81.9% compared to control diet. The best A/G ratio occurred by using WB and WB+XY compared to control group. There were significant differences between values of plasma total lipid recorded by birds fed different dietary treatments.

The birds fed control diet recorded significantly the highest value while birds fed WB+DW recorded significantly the lowest value. Also, significant differences were detected between values of plasma total antioxidants capacity of birds fed different treatments. Compared to birds fed control diet, WB diet numerically increase plasma total antioxidants capacity. In this respect, Ali *et al.* (2008) found that birds fed WB diet significantly increased plasma total antioxidants capacity compared to control. Data in Table(5) indicated that significant differences between values of plasma phosphorus recorded by birds fed different treatments. The WB and WB+XY diet increased level of plasma phosphorus by 48.54% and 52.19%, respectively, compared to control diet.

**Table (5). Effect of low energy diet supplemented with xylanase, fresh and dried whey on some blood parameters at 5 weeks**

Treatment	Cholesterol (mg/dl)	T. proteins (g/dl)	Albumin (g/dl)	Globulins (g/dl)	A/G	T. lipid (mg/dl)	Antioxidants (mmol/l )	Phosphorus (mg/dl)
Control	90.35 <sup>a</sup>	2.82 <sup>b</sup>	2.01 <sup>a</sup>	0.81 <sup>c</sup>	2.47 <sup>a</sup>	250.89 <sup>a</sup>	2.30 <sup>ab</sup>	6.86 <sup>b</sup>
WB	78.20 <sup>ab</sup>	3.05 <sup>ab</sup>	1.30 <sup>cd</sup>	1.74 <sup>a</sup>	0.75 <sup>de</sup>	195.31 <sup>cd</sup>	2.48 <sup>a</sup>	10.19 <sup>a</sup>
WB+ XY	74.28 <sup>ab</sup>	2.87 <sup>b</sup>	1.10 <sup>d</sup>	1.77 <sup>a</sup>	0.62 <sup>e</sup>	191.17 <sup>d</sup>	2.43 <sup>a</sup>	10.44 <sup>a</sup>
WB + FW	66.24 <sup>b</sup>	2.79 <sup>b</sup>	1.39 <sup>bcd</sup>	1.40 <sup>b</sup>	1.03 <sup>cd</sup>	213.28 <sup>bc</sup>	2.53 <sup>a</sup>	7.03 <sup>b</sup>
WB + DW	58.09 <sup>b</sup>	2.78 <sup>b</sup>	1.53 <sup>bc</sup>	1.24 <sup>b</sup>	1.24 <sup>bc</sup>	124.52 <sup>e</sup>	2.24 <sup>ab</sup>	8.13 <sup>b</sup>
WB+ XY+ FW	71.79 <sup>ab</sup>	3.40 <sup>a</sup>	2.04 <sup>a</sup>	1.36 <sup>b</sup>	1.52 <sup>b</sup>	229.19 <sup>b</sup>	2.54 <sup>a</sup>	8.26 <sup>b</sup>
WB+ XY+ DW	92.13 <sup>a</sup>	3.09 <sup>ab</sup>	1.71 <sup>ab</sup>	1.37 <sup>b</sup>	1.25 <sup>bc</sup>	198.31 <sup>cd</sup>	2.11 <sup>b</sup>	7.54 <sup>b</sup>
<b>SEM</b>	±7.08	±0.151	±0.108	±0.103	±0.116	±6.50	±0.093	±0.506

*a,b,c,d Means in the same column with different superscripts are significantly different (P<0.05).*

*WB= Wheat bran, XY=Xylanase, FW=fresh whey, DW=dried whey.*

The endogenous phytase inclusion of WB diet had beneficial effect on plasma phosphorus confirmed by Cavalcanti and Behnke (2004) who showed that the WB can be utilized as a viable source of phytases. Juanpere *et al.* (2005) found that wheat-based diet had high values of total phosphorus retention indicating that this effect may be due to its endogenous phytase activity. These results agree with those obtained by Ali *et al.* (2006) who found that the hens fed WB-diet increased phosphorus serum by 60.38% compared to hens fed control diet. Also, Ali *et al.* (2008) found with broiler that WB diet increased the plasma phosphorus by 67.65% compared to broiler fed control diet. On the other hand, the WB contain many types of antioxidants which may protect vitamin cholecalciferol from free radical and consequently increased plasma phosphorus. Most of the antioxidant compounds in wheat bran are bound to fiber, which survive gastrointestinal digestion reaching the colon intact (Fardet *et al.*, 2008). In this respect, Khan *et al.* (2010) showed stressful conditions may impair absorption or liver hydroxylation of cholecalciferol, which is one rationale for the use of Vit. D metabolites in broiler feed. Mohammed *et al.* (1991) found that high levels of cholecalciferol have increased the utilization of phytate phosphorus and the retention of calcium and phosphorus. The concentrations of calcium and phosphorus minerals in the serum increased progressively in birds at both 21 and 42 days of age when fed diet supplemented with high level of VIT-D3 (Khan *et al.*, 2010). The work done by Ali *et al.* (2016) with broiler diet demonstrated that antioxidants (other than WB diet) like canthaxanthin increased level of plasma phosphorus by 60.23 % compared to control. The addition of XY to WB diet numerically increasing plasma phosphorus compared to birds fed WB diet alone. However, Van der Klis *et al.* (1995) found a significant positive influence of endoxylanase supplementation to wheat-based diets on the absorption of calcium, magnesium, sodium and potassium in broilers, but there was no effect on phosphorus absorption. Further studies are needed to know the reason of increasing plasma phosphorus when diet contain antioxidants.

#### **Cellular immunity:**

The effect of dietary treatments on red blood cell indices and cellular immunity are presented in Table (6). There were significant differences between hemoglobin concentrations, the birds fed control diet recorded significantly the highest values while birds fed WB+XY+FW recorded the lowest values. Data in Table (6) indicated that there were insignificant differences between values of cellular immunity recorded by birds fed different treatments.

#### **CONCLUSION**

It could be concluded that the valuable nutrients and antioxidants presence in wheat bran the main reason to overcome the lower energy in WB diet. Using 30% wheat bran alone or with xylanase in broiler diet with low energy enhanced broiler performance.

**Table (6): Effect of low energy diet supplemented with Xylanase, fresh and dried whey on red blood cell indices and cellular immunity of broiler 5 weeks.**

Treatments	RBC	HB	HT	MCV	MCH	MCHC	H	L	HL ratio
Control	3.33	13.20a	33.40	100.28	39.57	39.53	26.93	67.57	0.40
WB	3.47	12.90 <sup>ab</sup>	33.73	97.37	37.21	38.31	30.40	65.10	0.47
WB+ XY	3.47	11.70 <sup>bc</sup>	29.40	85.34	33.83	39.94	30.27	65.43	0.47
WB + FW	3.30	11.20 <sup>c</sup>	30.07	91.26	33.99	37.31	29.77	65.90	0.45
WB + DW	3.27	11.70 <sup>bc</sup>	30.40	92.83	35.88	39.12	30.17	64.67	0.47
WB+ XY+ FW	3.17	10.53 <sup>c</sup>	29.40	92.86	33.31	35.80	28.57	66.47	0.43
WB+ XY+ DW	3.23	11.37 <sup>c</sup>	29.07	89.84	35.17	39.25	29.80	65.67	0.46
SEM	0.033	0.231	0.572	1.694	0.638	0.751	0.529	0.501	0.011

*a,b,c Means in the same column with different superscripts are significantly different (P<0.05). WB= Wheat bran, XY=Xylanase, FW=fresh whey, DW=dried whey, RBC=red blood cell (10<sup>6</sup> / mm<sup>3</sup>), Hb= hemoglobin concentration (g/dl), Ht= hematocrit%, MCV=Mean Corpuscular Volume (μm<sup>3</sup>), MCH= Mean Corpuscular Hemoglobin (Pg), MCHC= Mean Corpuscular Hemoglobin Concentration (g/dl), WBC= white blood cells, H=heterophilus, L=lymphocytes, H/L=H/L ratio.*

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## إستخدام الزيلينيز وشرش اللبن الطازج والمجفف كلا بمفرده أو في مخاليط لتحسين علائق كتاكيت التسمين المنخفضة في الطاقة والمحتوية علي نخالة القمح

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تهدف هذه الدراسة الي امكانية إستخدام انزيم الزيلينيز وشرش اللبن الطازج والمجفف كلا بمفرده أو في صورة مخاليط وذلك لتحسين أداء الطيور المغذاة علي عليقة تحتوي علي 30% نخالة قمح والمنخفضة في الطاقة . هذه التجربة تمت في مصر في الفترة من ابريل الي مايو (23.9 - 34.8 درجة مئوية) . استخدم في هذه الدراسة عدد 210 كتكوت سلالة كوب غير مجنس عمر 7 ايام وقسمت عشوائيا الي 7 معاملات وهي : الكنترول (عليقة لا تحتوي علي نخالة القمح) ، عليقة تحتوي علي نخالة القمح بنسبة 30%، عليقة تحتوي علي نخالة القمح بنسبة 30% + 0.1% انزيم الزيلينيز ، عليقة تحتوي علي نخالة القمح بنسبة 30% + 1% شرش لبن طازج ، عليقة تحتوي علي نخالة القمح بنسبة 30% + 0.5% شرش لبن مجفف ، عليقة تحتوي علي نخالة القمح بنسبة 30% + 1% شرش لبن طازج + 0.1% انزيم الزيلينيز ، عليقة تحتوي علي نخالة القمح بنسبة 30% + 0.5% شرش لبن مجفف + 0.1% انزيم الزيلينيز. وكانت النتائج كالآتي :

عند عمر 35 يوم سجلت الطيور المغذاة علي علائق تحتوي علي نخالة القمح بنسبة 30% وزن جسم اعلي مقارنة بالكنترول ، وكذلك فان الطيور المغذاة علي علائق النخالة المضاف اليها انزيم الزيلينيز سجلت اعلي وزن جسم معنويا مقارنة بعلائق النخالة بمفردها . في حين ان الطيور المغذاة علي علائق تحتوي علي نخالة القمح والمضاف اليها الشرش المجفف لم تعطي اي تحسن في وزن الجسم . سجلت الطيور المغذاة علي علائق النخالة المضاف اليها الزيلينيز زيادة معنوية في النسبة المئوية للذبيحة مقارنة بعلائق النخالة بمفردها او الكنترول . ارتفع مستوى الجلوبيولين والفسفور في بلازما الدم ( 114.80 ، 48.54 علي التوالي ) للطيور المغذاة علي النخالة بمفردها بالكنترول .

تشير الدراسة الي ان اضافة انزيم الزيلينيز للعلائق المحتوية علي نخالة القمح تحت ظروف التجربة حسن من الاداء الانتاجي للطيور .

ويمكن التوصية باستخدام علائق تحتوي علي 30% نخالة قمح بمفردها او مع اضافة الزيلينيز لتحسين الاداء الانتاجي لدجاج التسمين .

الكلمات الدالة : الزيلينيز , شرش الجاف , شرش طازج , عليقة منخفضة الطاقة , دجاج التسمين.