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EFFECT OF DIETARY MANGO SEED KERNEL (MANGIFERA INDICA) AS PARTIAL REPLACEMENT OF CORN ON PRODUCTIVE AND PHYSIOLOGICAL PERFORMANCE OF GROWING GIMMIZAH COCKERELS

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ABSTRACT: An investigation was undertaken to study the effects of feeding mango seed kernel (MSK) as partially substituting of yellow corn on productive performance and physiological parameters of Gimmizah cockerels. A total number of 100 Gimmizah cockerels aged 28 days were distributed into four groups. Each group was represented by five replicates (5 cockerels per rep.) from 4 -16 wk of age. The first group (control) fed the basal diet. The second, third and fourth groups were fed the basal diet with the substitution of yellow corn with MSK with 10, 15 and 20%, respectively. Body weight and body weight gain were increased when used 10% level of MSK. Feed consumption was significantly decreased and feed conversion was significantly improved overall period for 10% MSK. Carcass characteristics had not affected. While, blood constituents (Hb, PCV%, RBCS, and WBCS counts) were significantly improved. Lymphocyte (L) count for birds fed 10 and 15% MSK was significantly increased and heterophils (H) count and H/L ratio was significantly decreased. The immunological status was significantly improved due to an increase in globulin, IgG and IgM for cockerels fed diets containing the MSK levels (10%,15%). Plasma cholesterol, CK and MDA was significantly decreased by increasing MSK levels. Serum alkaline phosphatase (ALP) activity was significantly reduced when a cockerel fed diet containing 10 and 15% MSK. Bacterial count in the intestine and in fresh breast and thigh meat were decreasing by increasing MSK levels. All MSK levels used were shown better economic efficiency than the control group. The relative economic efficiency of 10% MSK replacement of corn increased with 48% than the control group. It could be concluded that MSK can be used up to 10% without any adverse effect on performance and improve blood parameters and the economic efficiency of Gimmizah cockerels during the growing period.

Keywords: Mango seed kernel, performance, physiological parameters, economic efficiency.

INTRODUCTION

The high cost of feed still remains the greatest constraint to poultry production in Egypt. Yellow corn has been the main energy source mainly imported with hard currency. Therefore, it is necessary to search for locally available, cheap, safe and y adequate substitutes for corn in poultry feeding. The agro-industrial by-products with the high nutritional value may be used in poultry feeding as a partial replacement of corn as well as decrease environmental pollution. In the last years, the mango (Mangifera indica Linn.) crop production has increased. Mango is one of the most important tropical fruits in the world. During the processing of mango, some by-products such as peel, seed, and kernel are obtained. The kernel contained in the seed (mango seed kernel: MSK) represents 68% of mango seeds and 17-22% of the mango fruit (Odunsi, 2005).

Kittiphoom (2012) showed that the mango seed kernel is a nutritional promising seed because of its high levels of carbohydrate, oil, calcium, potassium, magnesium and antioxidant vitamins such as vitamins C, E and A. Mango seed kernel (MSK) is a good source of starch (58-80%) (Garg and Tandon, 1997; Sandhu and Lim, 2007) and is high in fats (Diarra *et al.,* 2011) which combine to give a metabolizable energy (ME) value comparable to that of maize. Ravindran and Rajaguru (1985) reported that only 52.5% of MSK carbohydrates were metabolized by poultry.

The protein content of dried MSK (6-13%) has a good essential amino acid profile especially in terms of lysine and methionine comparable to that of maize (Fowomola, 2010; Diarra *et al*., 2011). Mango seed kernel (MSK) meal is a good source of stearic (24-57%) and oleic (34-56%) acids which can be fractionated to yield olein and stearin (Gunstone, 2006).

Mango seed kernel (MSK) consists of high quality of fat and protein in addition to high levels of natural antioxidants, it could be used as a potential source for functional food ingredients and antimicrobial compounds.

Diarra *et al.* (2011) reported that 50% and 75% of maize can be replaced by boiled mango seed kernel in broiler chicken starter and finisher diets respectively without adverse effect on blood parameters. While Teguia (1995) reported that the level of inclusion raw mango seed kernel in poultry diets has been low because of the presence of tannins which have been reported to reduce chick growth. However, few studies have been carried out on the MSK application in poultry.

Therefore, this study was undertaken to evaluate the effect of partially substituting corn by MSK (Mangifera indica) in cockerels diet on growth performance, carcass characteristics, blood and plasma constituents, and economic efficiency.

MATERIALS AND METHODS

The present study was carried out at El-Sabahia Poultry Research Station, Alexandria Governorate belonging to Animal Production Research Institute, Agriculture Research Center. The experiment has conducted the effect of partially substituting yellow corn with mango seed kernel (MSK) on productive, physiological performance and immune response of the Gimmizah cockerels diet.

Preparation of mango seed kernel:

The mango seeds were collected from juice production factories after that dried it in the sun then broken seeds to obtain kernel. The kernel was sunny dried, ground, and supply to the cockerels ration

as partial replacement of corn with 10,15 and 20%. The mango seed kernel was analyzed at the Laboratory of poultry nutrition, animal production research institute (Table 1). The metabolizable energy (ME) content was calculated according to Steel and Torrie (1980) as :

ME (kcal/kg) = 432 + 27.91 (CP + NFE + 2.25 × EE).

Birds, management and experimental design: A total number of 100 Gimmizah cockerels aged 28-day were individually weighed and randomly divided into four treatment groups. Each treatment group was represented by five replicates (5 cockerels per each cage) from 4 -16 wk of age. The first group was used as a control fed the basal diet. The second, third and fourth groups were fed the basal diet with the substitution of yellow corn with a ground mango seed kernel (MSK) with 10, 15 and 20 %, respectively. The composition and calculated analysis of the experimental diets are shown in Table 1. All birds were kept under similar managerial conditions in rearing cages. Feed and water were provided ad libitum throughout the experimental period.

Measurements: All birds were individually weighed (g) and recorded every 2 weeks. Feed consumption and mortality during these periods were recorded. Body weight gain and feed conversion ratio (feed/g gain) were calculated.

Carcass traits: At 16 weeks of age, ten cockerels from each treatment were randomly taken and slaughtered for carcass evaluation. The carcass was eviscerated, liver, gizzard, heart, and spleen were weighed and expressed as a percentage of live body weight.

Blood analyses: At the end of the experiment, two blood samples (3 ml, each) were collected from the brachial vein, (one into a heparinized tube to separate plasma and the other one into the un-heparinized tube) of five birds/treatment. The fresh blood samples were used for the determination of hemoglobin (Hb), red blood cell count (RBCs), packed cell volume (PCV), white blood cell counts (WBCs). Plasma was immediately separated by centrifugation for 10 minutes at 3200 rpm. Plasma total protein (g/dl), albumin (g/dl), globulin (mg/dl), cholesterol, triglyceride, alkaline phosphatase (ALP), creatinine kinase (CK), aspartate aminotransferase (AST), alanine aminotransferase (ALT), Malondialdehyde (MDA), IgG and IgM were determined using commercial Kits.

Microbiological study: Intestinal aerobic, anaerobic and total coliform count were determined according to the American Public Health Association (1985). Psychrophilic and Coliform bacteria were determined in fresh breast and thigh meat.

Economic efficiency: Total body weight cost and total feed cost (L.E) for each treatment were calculated according to the local market prices of the ingredients and body weight of birds. Economic efficiency (EE) and relative economic efficiency (REE) were calculated according to the following equations:

Economic Efficiency (EE) = Net revenue / Total cost X100.

Relative economic efficiency (REE), assuming control treatment = 100 %.

Statistical analysis: Data were analyzed with SPSS software (2010). One-way ANOVA and Duncan's multiple range test (1955) for comparisons between groups were applied.

RESULTS AND DISCUSSION

The results of the effect of mango seed kernel (MSK) as partial replacement of

corn on body weight and body weight gain of Gimmizah cockerels were shown in Table 2. Body weight and body weight gain were increased when used 10% level of MSK compared to other treatments. While 15 and 20% of MSK had an adverse effect on body weight and body weight gain at the overall period studied. These results agree with the observations of Dharmendra *et.al.* (2010) who found that the body weight gain was similar in all the dietary treatments when replaced 0, 2.5, 5, 7.5 and 10% levels of rice polish with MSK as a source of energy in starter broilers. Also, Patil *et al.* (1982) reported that replacing 14.1% dietary corn with raw MSK had no adverse effects on broiler chicken growth, but when the replacement increased to 28.2% had an adverse effect on growth. However, Teguia (1995) observed adverse effects on weight gain of broiler chickens fed 20% ground MSK as a replacement of corn. In correlation, Odunsi (2005) reported significant growth depression in broilers fed more than 10% raw MSK as a replacement for corn, while 20% replacement with soaked MSK had no adverse effects on broiler growth. The same trend was observed by Diarra and Usman (2008) and Diarra *et al*. (2011) who found that the performance depressed in birds fed raw MSK above 10% of the diet (as a replacement of corn). Similarly, Joseph and Abolaji (1997) observed no adverse effects of feeding 10% raw or 20% boiled mango kernel as a replacement for corn on broiler performance.

Feed consumption was significantly decreased in the overall studied period (4-16 wk) for 10% MSK compared with other treatments (Table 3). Also, during the same period (4-16 wk) feed conversion was significantly improved by using 10% MSK compared to other treatments while using 15 and 20% MSK declined feed conversion ratio. While, Dharmendra *et al*. (2010) reported that there were no significant differences between all studied treatments when fed different levels of MSK (0,2.5,5.0,10%) as the replacement of corn in feed conversion ratio. They found that increasing MSK levels in broiler diet increased the quantity of feed needed for each unit of weight gain. Teguia (1995) observed adverse effects on feed consumption of broiler chickens fed 20% ground MSK as a replacement of corn. The increased requirement of feed with increased levels of MSK may be due to the presence of tannin in MSK which decreased the utilization of protein (Jansman *et al.*, 1995). Odunsi (2005) investigated that broiler performance was maintained at 10% inclusion of raw mango seed kernel meal. While inclusion rates as low as 5 to 10% of raw MSK depressed growth and feed consumption in broiler chicks (El-Alaily *et al*., 1976; Diarra and Usman 2008 and Teguia 1995). Also, El-Alaily *et al.* (1976) reported that the feed efficiency reduced as MSK inclusion increases in the feed.

The present results revealed that growth performance depression occurred for cockerels fed more than 10% MSK as the replacement of corn may be due to the presence of anti-nutritional factors in MSK.

Anti-nutritional factors of mango seed kernels are fairly rich in tannins, which progressively lead to reduced growth rates and less efficient feed utilization when included as a major component in diets for poultry. They also contain cyanogenic glucosides, (64 mg/kg DM), oxalates (42 mg/kg DM) and trypsin inhibitory (20 TIU/g DM) (Ravindran and Sivakanesan, 1996). These anti-nutrients chelate divalent ions like Ca2+, Mg2+, Fe2+, and Zn2+ and also react with the charged groups of protein and polysaccharides thereby forming indigestible complexes while the toxic substances interfere with nutrient bioavailability and utilization (Beyene and Araya, 2015**)**. In addition to the bitter taste of MSK has been attributed mainly to the presence of tannins which could be

reduced and improve the performance of broiler by MSK processing as reported by Ravindran and Sivakanesan (1996) and Arogba (2000). Therefore, the MSK processing (soaked, autoclaved, boiled, heating …etc) is required for better utilization of MSK.

Carcass characteristics:

There were no significant differences between all MSK treatments studied and control for carcass characteristics (Table 4). The same findings obtained by Dharmendra *et al.* (2010) who investigated that when used MSK as partial replacement of rice polish up to 10 % , the MSK inclusion had no significant (P>0.05) influence on the dressed weight, eviscerated weight and ready to cook chicken weight and also no significant (P>0.05) effect on weight of liver, gizzard, heart, and spleen were observed.

Hematological parameters:

The results in Table 5 showed that Hb, PCV%, RBCS, and WBCS counts were significantly ($p \leq 0.05$) influenced by replacing dietary corn (10, 15 and 20%) with MSK. The highest value of Hb and PCV% were recorded for cockerels fed 10% MSK as a replacement for corn followed by that fed 15 % while, no significant differences were observed between 20% MSK and control group. The same trend was shown in the RBCs and WBCS counts. Our findings were supported by Odunsi (2005) who found that fed broilers 10% MSK replacing maize weight for weight significantly increase Hb content. Similar results were confirmed by Amao and Siyanbola (2013) who reported that replacement of maize by dry heat-treated mango kernel up to 20% of maize in broiler diet caused significantly increased in Hb concentration. On the other hand, Soomro *et al*. (2013) indicated that Hb, RBCs and WBCS counts were not affected by using mangchico pulp as a supplement at the rate of 2, 3 and 4% per kg for the broiler. The hematological indices are the reflection of the effect of dietary treatments on the birds. This improvement in Hb, PCV %, RBCS and WBCS counts in cockerels fed 10 and 15% MSK replacement of corn may be attributed to the health-promoting properties of the MSK, such as analgesic, antioxidant, antimicrobial, anti-inflammatory, and antifungal activities (Cojocaru *et al*.,1986, Anila and Vijayalakshmi 2003 and Garrido *et al*., 2004).

Table 5 showed that there was a significant effect ($p \leq 0.05$) of replacing MSK with 10,15 and 20% with corn in cockerels feed on lymphocytes (L), heterophils(H) count and H/L ratio, which lymphocyte count for cockerels fed 10 and 15% MSK was significantly greater than control and 20% groups. There were also no significant differences in lymphocyte count between control and 20% groups. Cockerels fed 10 and 15% MSK as replacement of corn had a significant decrease ($p \leq 0.05$) on heterophils count and H/L ratio compared with control and 20% groups. The present study confirmed by using MSK either boiled or soaked on broilers (Daudu *et al*., 2015). On the other hand, Odunsi (2005) reported that lymphocyte count was not affected by replacing MSK with maize weight for weight at 0, 5,10,15,20 and 25 % in broiler diet. It is clear from the improvement of the present results in the immune status of cockerels fed 10 and 15% MSK may be attributed to the MSK contains various phenolic compounds which have an antioxidant action (Ahmed, 2014).

Biochemical parameters:

Table 6 showed the effect of using MSK as a partial replacement of corn on plasma total protein, albumin, and globulin of Gimmizah cockerels. The results revealed a significant increase in total protein and globulin in 10 and 15% MSK groups. Cockerels fed 10% MSK had the highest values of total protein and globulin but, no significant differences were observed between control and 20% groups. With respect to plasma albumin, no significant differences were noticed in plasma albumin among the experimental groups. These results are in agreement with Odunsi (2005) who found that replacing MSK with maize weight for weight at 10 % in broiler diet resulted in increasing total protein and globulin values. Additionally, Amao and Siyanbola (2013) found that total protein value was significantly high ($p \leq 0.05$) in the birds fed with 10% heat-treated mango kernel. From the present results, the increase in plasma total protein and globulin of cockerels fed on 10% MSK replacement of corn may be due to the increase in protein synthesis. However, increased globulin value may be an indication of increased immunity in the cockerels since the liver will be able to synthesize enough globulins for immunologic action.

The results of plasma immunoglobulin, IgG and IgM for Gimmizah cockerels are presented in Table 6. Using MSK at 10 and 15% replacement of corn caused a significant ($p \leq 0.05$) increase in plasma IgG and IgM values compared with the control group. While no significant differences were observed between 20% MSK and control groups. Additionally, the highest IgG and IgM values were recorded for cockerels fed diet containing the lowest MSK level (10%). The improvement in immunological status in the current results may be attributed to the MSK contains various phenolic compounds which considered as antimicrobial, antifungal, antiviral (Cojocaru *et al*., 1986) and antibiotics against pathogenic microorganism (Mutua *et al*., 2017).

Results of Table 6 indicated that there was a significant decrease ($p \leq 0.05$) in plasma cholesterol by increasing MSK levels as a replacement of corn compared with the control group. While triglyceride content was not affected by replacing dietary corn with MSK levels. Our finding was supported by Zhang *et al*. (2016) who reported that dietary 0.28% mango saponin supplementation decreased plasma total cholesterol content in cockerels. It could be explained by the presence of mangiferin in mango saponin. The hypocholesterolemia effect of MSK may be related to containing flavonoids components that may prevent lipid peroxidation which regulates cholesterol synthesis.

Serum creatinine kinase (CK) activity for Gimmizah cockerels was significantly decreased ($p \leq 0.05$) for treated groups (Table 6). The lowest CK level was recorded at 10% MSK replacement with corn. Marianne *et al*. (2012) indicated that, raised levels of serum CK were closely associated with cell damage, muscle cell disruption or disease. The improvement of the muscle cells in the current study by using MSK in cockerels diet at 10 and 15% replacement with corn related to the phenolic compounds which may prevent oxidation reactions in the cell.

Lipid peroxidation:

Results indicated that plasma malondialdehyde (MDA) activity was significantly affected by using MSK in

Gimmizah cockerels feed (Table 6). Whereas, MDA concentration significantly decreased ($p \leq 0.05$) for treated groups compared with the control group. However, the lower replacement rate (10%) for corn with MSK obtained a reduction of 24.79 % compared with control. Therefore, this rate was effective in retarding lipid peroxidation. Decreasing the MDA level for the groups supplied with MSK is an indicator of protection against oxidative status. These findings are confirmed with those previously reported by Freitas *et al*. (2015) who demonstrated that, mango peel extract and mango seed extract are used in the broiler's diet at 200 and 400 ppm resulted in reduction of lipid oxidation and mango seed extract at concentration of 400 ppm was more effective than traditional antioxidant treatments, in addition to retarding MDA of chicken meat stored undercooling for 15 days. The improvement in antioxidant status may be related to the MSK containing mangiferin, phenolic acids, and tocopherols, which are compounds that have antioxidants properties and potential factors that inhibit oxidative catalysts (Maisuthisakul and Gordon, 2009). Mangiferin has proven antioxidant activity by oxidative stability, free radical scavenging (Barreto *et al.,* 2008).

Liver enzymes:

Serum transaminases (AST and ALT) activity were not affected by using MSK (Table 7) in cockerels feed. While serum alkaline phosphatase (ALP) activity was significantly ($p \leq 0.05$) reduced when cockerels fed diet containing 10 and 15% MSK. The reduction of ALP activity reflected MSK may make cell membrane stabilization and protect liver cells from damage (Baba *et al.,* 2016). These results are in agreement with findings by Zhang *et al.* (2016) who found that no differences in AST and ALT activity when broilers fed diet containing 0.14 and 0.28 % mango saponin. In addition, Daudu *et al.* (2015) recorded that serum ALP activity for broiler chickens fed mango kernel soaked was significantly lower than birds fed control diet. The present results concerning the decreasing of the serum ALP activity may be attributed to higher nutritive values and biological activity contents in mango seed kernel at levels of 10 and 15% which could prevent lipid peroxidation.

Microbiological parameters:

The effect of using mango seed kernel (MSK) as partial replacement of corn on a count of aerobic, anaerobic and total coliform bacteria in the intestine of Gemmazah cockerels was shown in Table 7. All bacterial count (aerobic, anaerobic and total coliform) was decreased by increasing MSK levels compared to the control group. This result showed that MSK acts like an antibiotic. This is may be due to that MSK could be used as antimicrobial compounds due to its high quality of fat and protein as well as high levels of natural antioxidants. Similar results were obtained when counting Psychrophilic and Coliform bacteria in fresh breast and thigh meat (Table 8) which found the decreasing of Psychrophilic and Coliform bacteria by increasing MSK levels. This result may be due to the decreasing effect of MSK on microbial load in the intestine. The current results may be attributed to the MSK contains various phenolic compounds which considered as antimicrobial, antifungal, antiviral (Cojocaru *et al.,* 1986) and antibiotics against pathogenic microorganism (Mutua *et al*., 2017).

Economic efficiency:

Table 9 showed the economic efficiency of using mango seed kernel (MSK) as a partial replacement of corn for growing Gimmizah cockerels. All levels of MSK used as a replacement for corn were shown better economic efficiency than the control group. The best economic efficiency was occurred from 10% MSK replacement of corn compared to all treatments. This result was obtained because MSK is a mango byproduct and it handled at a cheaper rate than yellow corn, in addition to decrease feed consumption which may be due to bitter taste of MSK. The relative economic efficiency of 10% MSK replacement of corn increased with about 48% than the control group. Similarly, Dharmendra *et al*. (2010) reported that the feed cost/kg weight gain of broilers was lowest in the group fed 10 % rice polish as replacement of corn.

CONCLUSION

It could be concluded that mango seed kernel can replace part of cockerels ration up to 10% as partial replacement of corn without any adverse effect on performance and carcass traits, in addition, to improve blood parameters with lower feed cost and higher economic efficiency. The processing of MSK (soaked, autoclaved, boiled, heating …etc) is recommended for better utilization of using higher levels of MSK. Further study on feeding of mango seed-kernel waste should be done as an energy source for poultry feeding.

Table (1): Composition and calculated analysis of the experimental diets

Ingredients (%)	Starter (0-8 wks)				Grower (8-16wks)			
	Control	10% MSK	15% MSK	20% MSK	Control	10% MSK	15% MSK	20%MSK
Yellow corn	64.00	57.6	54.4	51.2	63.00	56.7	53.55	50.4
Mango seeds kernel (MSK)	0	6.4	9.6	12.8	0	6.3	9.45	12.6
Soybean meal (44%)	32.10	32.10	32.10	32.10	17.60	17.60	17.60	17.60
Wheat bran	0	0	0	0	15.68	15.68	15.68	15.68
Dicalcium phosphate	1.80	1.80	1.80	1.80	1.25	1.25	1.25	1.25
Limestone	1.40	1.40	1.40	1.40	1.80	1.80	1.80	1.80
DL-Methionine	0.10	0.10	0.10	0.10	0.07	0.07	0.07	0.07
NaCl	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Vit. and mineral (premix)[1]	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	100	100	100	100	100	100	100	100
Calculated analysis[2] %								
Crude protein	19.0	19.0	19.30	19.40	15.0	15.0	15.25	15.40
ME (Kcal/kg diet)	2860	2860	2860	2860	2710	2710	2710	2710
Crude fat	2.91	3.15	3.28	3.39	3.28	3.52	3.65	3.76
Crude fiber	3.81	4.15	4.32	4.50	4.14	4.47	4.65	4.81
Calcium	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Available phosphorus	0.47	0.47	0.46	0.46	0.40	0.39	0.38	0.38
DL-Methionine	0.43	0.42	0.41	0.41	0.35	0.33	0.33	*0.32
L-Lysine	1.099	1.085	1.05	1.07	0.77	0.77	0.75	0.74

Chemical analysis of MSK[3]	Crude protein %	ME (Kcal/kg diet)[4]	Crude fat %	Crude fiber %
	10.5	3265	7.3	7.6

[1]Three kg of vitamin-mineral premix per ton of feed supplied each kg of the diet with Vit. A 12000 IU; Vit. D_3 2000 IU; Vit. E. 10mg; Vit. K3 2mg; Vit.B_1 1mg; Vit. $B_2$4mg; Vit. B_6 1.5 mg; Pantothenic acid 10mg; Vit.B_{12} 0.01mg; Folic acid 1mg; Niacin 20mg; Biotin 0.05mg; Choline chloride (50% choline) 500 mg; Zn 55mg; Fe 30mg; I 1mg; Se 0.1mg; Mn 55mg and ethoxyquin 3000 mg.

[2]According to Feed Composition Tables for animal and poultry feedstuffs used in Egypt (2001).

[3] Analyzed at Laboratory of poultry nutrition, animal production research institute.

[4]Calculating according to Steel and Torrie (1980).

Table (2): Effect of using mango seed kernel (MSK) as partial replacement of corn on body weight and body weight gain of Gimmizah cockerels.

Treatments	Body weight (g)				Body weight gain (g)			
	4 wks	8 wks	12 wks	16 wks	4-8 wks	8-12 wks	12-16 wks	4-16 wks
Control	342.72	802.00	1228.40^{ab}	1713.36^{a}	459.28^{a}	426.40^{bc}	484.96^{a}	1370.64^{a}
10% MSK	342.68	796.28	1277.08^{a}	1743.20^{a}	453.60^{a}	480.80^{a}	466.12^{a}	1400.52^{a}
15% MSK	342.72	767.96	1209.96^{b}	1621.60^{b}	425.24^{a}	442.00^{b}	411.64^{b}	1278.88^{b}
20% MSK	342.80	758.32	1150.56^{c}	1622.60^{b}	415.52^{b}	392.24^{c}	472.04^{a}	1279.80^{b}
SEM	2.69	7.46	10.56	14.23	6.62	7.47	9.69	13.77

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

Table (3): Effect of using mango seed kernel (MSK) as partial replacement of corn on feed consumption and feed conversion ratio of Gimmizah cockerels.

Treatments	Feed consumption (g/chick/day)				Feed conversion ratio (g feed/g gain)			
	4-8 wks	8-12 wks	12-16 wks	4-16 wks	4-8 wks	8-12 wks	12-16 wks	4-16 wks
Control	56.88^{a}	74.15^{a}	86.27^{a}	72.43^{a}	3.51^{ab}	4.90^{ab}	5.03^{b}	4.45^{b}
10%MSK	53.42^{b}	71.51^{b}	82.81^{c}	69.25^{c}	3.30^{b}	4.20^{c}	5.02^{b}	4.16^{c}
15%MSK	55.67^{ab}	71.84^{b}	85.03^{ab}	70.85^{b}	3.71^{a}	4.59^{bc}	5.89^{a}	4.66^{a}
20%MSK	55.73^{ab}	71.39^{b}	84.02^{bc}	70.38^{bc}	3.76^{a}	5.16^{a}	5.11^{b}	4.63^{ab}
SEM	0.432	0.337	0.405	0.313	0.059	0.095	0.127	0.046

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

Table (4): Effect of using mango seed kernel (MSK) as partial replacement of corn on carcass relative weight and percentage of some carcass traits of Gimmizah cockerels.

Treatments	Carcass%	Gizzard%	Liver%	Heart%	Spleen%
Control	67.96	2.15	1.81	0.59	0.25
10%MSK	67.24	2.06	2.08	0.51	0.31
15%MSK	68.38	2.25	1.91	0.49	0.24
20%MSK	68.51	2.00	1.73	0.50	0.26
SEM	0.288	0.066	0.074	0.018	0.011

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

Table (5): Effect of using mango seed kernel (MSK) as partial replacement of corn on hematological parameters of Gimmizah cockerels.

Parameters	MSK levels				SEM
	Control	10%MSK	15%MSK	20%MSK	
Hb (g/dl)	10.28 c	12.02a	11.54 b	10.97 c	0.151
PCV (%)	29.48 c	35.44 a	32.00 b	28.88 c	0.451
RBCs (106/mm3)	2.76 c	3.29 a	3.11 b	2.75 c	0.040
WBCs (103/mm3)	4.33 b	5.12 a	4.97a	4.32 b	0.069
Lymphocytes% (L)	64.00 c	69.00 a	67.00 b	64.00 c	0.668
Heterophils% (H)	33.20 a	27.56 b	28.80 b	33.00 a	0.467
H/L ratio	52.29 a	40.04 b	42.56 b	51.39 a	1.079

a,b,c Means in the same row with different superscripts are significantly different (P<0.05)
Hb: hemoglobin, PCV: packed cell volume, RBCs: red blood cell, WBCs: white blood cell

Table (6): Effect of using mango seed kernel (MSK) as partial replacement of corn on some blood constituents of Gimmizah cockerels.

Parameters	MSK Levels				SEM
	Control	10% MSK	15% MSK	20% MSK	
Total protein(g/dl)	5.44b^{c}	6.04^{a}	5.74^{ab}	5.20^{c}	0.103
Albumin (g/dl)	3.62	3.72	3.56	3.62	0.098
Globulin (g/dl)	1.82b^{c}	2.32^{a}	2.18^{ab}	1.58^{c}	0.094
IgG (mg/dl)	83.32^{c}	97.60^{a}	93 ^{ab}	86.80^{bc}	1.68
IgM (mg/dl)	173.20^{b}	233.60^{a}	226.20^{a}	171.80^{b}	6.81
Cholesterol (mg/dl)	143^{a}	133.60^{ab}	120.40^{bc}	110.60^{c}	4.01
Triglyceride (mg/dl)	92	88.20	90.40	90.20	1.23
CK (U/L)	37.04^{a}	20^{c}	28.27^{b}	35.84^{a}	1.59
MDA (umol/ml)	0.242^{a}	0.182^{d}	0.202^{c}	0.225^{b}	0.005
AST (U/L)	78.40	78.40	80.40	79.80	0.959
ALT (U/L)	22.60	23.20	25	24	0.417
ALP (U/L)	146.80^{a}	127.40^{c}	138.80^{b}	147.60^{a}	1.96

a,b,c,d Means in the same row with different superscripts are significantly different (P<0.05)
CK: creatinine kinase, MDA: Malondialdehyde, AST: aspartate aminotransferase, ALT: alanine aminotransferase, ALP: alkaline phosphatase.

Table (7): Effect of using mango seed kernel (MSK) as partial replacement of corn on aerobic, anaerobic and total coliform bacteria count in the intestine of Gimmizah cockerels .

Treatments	Aerobic	Coliform	Anaerobic
Control	$24x10^{8}$	$50x10^{7}$	$18x10^{3}$
10% MSK	$18x10^{8}$	$35x10^{4}$	$10x10^{2}$
15% MSK	$10x10^{7}$	$23x10^{4}$	$5x10^{2}$
20% MSK	$5x10^{7}$	$18x10^{4}$	$3x10^{2}$

Table (8): Effect of using mango seed kernel (MSK) as partial replacement of corn on Psychrophilic and Coliform bacteria in fresh breast and thigh meat of Gimmizah cockerels.

Treatment	Psychrophilic	Coliform	Psychrophilic	Coliform
	Breast meat		Thigh meat	
Control	5.90±0.03a	5.80±0.04a	5.85±0.02a	5.73±0.03a
10% MSK	5.81±0.05a	5.68±0.04a	5.70±0.04a	5.52±0.03a
15% MSK	4.39±0.01b	4.83±0.02b	4.93±0.03a	4.71±0.03b
20% MSK	4.11±0.02b	4.33±0.01bc	4.20±0.04b	4.64±0.01b

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

Table (9): Economic efficiency of using mango seed kernel (MSK) as partial replacement of corn for growing Gimmizah cockerels.

Criteria	Control	10 % MSK	15 % MSK	20 % MSK
Total feed consumption[1](kg)	6.10	5.82	5.95	5.91
Cost of Kg feed[2] (LE)	4.9	4.59	4.43	4.27
Chick cost at 28 day[3](LE)	14	14	14	14
Total cost[4](LE)	43.89	40.71	40.38	39.24
Body weight (kg)	1.713	1.743	1.622	1.623
Market price[5] (LE)	54.82	55.78	51.90	51.94
Net revenue[6](LE)	10.93	15.07	11.54	12.70
Economic efficiency (EE)[7]	0.25	0.37	0.29	0.32
Relative economic efficiency (REE)[8]%	100	148	116	128

1-Total Feed Consumption (Kg) = feed consumption during the experimental period (84 days).
2- Price of Kg diet = 4.9 LE. 3- Chick cost at 28 days =14 LE
4- Total cost (LE) = 1 * 2 + 3. 5- Market Price = BW * 32 LE.
6-Net Revenue (LE) = 5-4 .
7-Economic Efficiency (EE) = Net revenue / Total cost X100.
8- Relative economic efficiency (REE), assuming control treatment = 100 %.

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الملخص العربى

تأثير استخدام نواه بذور المانجو كبديل جزئى للذرة على الاداء الانتاجى و الفسيولوجى لديوك الجميزه في فترة النمو

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اجريت هذه التجربة لدراسة تاثير التغذية على نواة بذور المانجو كبديل جزئي للذرة الصفراء على الأداء الإنتاجي و الفسيولوجية والاستجابة المناعية لديوك الجميزة خلال فترة النمو. تم توزيع 100 ذكر جميزة عمر 28 يوما بشكل عشوائي في أربع مجموعات 25 ذكر لكل منها. قسمت كل مجموعة الى خمس مكررات (5 ذكور لكل قفص) واستمرت التجربه من 4 - 16 أسبوع. تم استخدام المجموعة الأولى كنترول وتم تغذيتها على العليقه الأساسية . تم تغذية المجموعة الثانية والثالثة والرابعة باستبدال الذرة الصفراء بنواة بذور المانجو المطحونة بنسبة 10 و 15 و 20 ٪ على التوالي. أوضحت النتائج ان استخدام مستوى 10 ٪ من نواة بذور المانجو حسن وزن الجسم ووزن الجسم المكتسب عند مقارنة مع المعاملات الأخرى. انخفض معنويا معدل استهلاك العلف وتحسن معنويا اجمالى التحويل الغذائي خلال فترة التجربه لمستوى10 ٪ نواة بذور المانجو مقارنة مع المعاملات الاخرى. لم توجد اى فروق معنويه في خصائص الذبيحة بين جميع المعاملات. أظهرت مكونات الدم أن قيم Hb و PCVو RBCS و WBCS تحسنت معنويا باستبدال الذرة جزئيا (10 و 15 و 20٪) بنواة بذور المانجو ، وكانت افضل النتائج للديوك التي تغذت على 10٪ نواة بذور المانجو . ذادت معنويا عدد الخلايا اللمفاوية للطيور التي تغذت على 10 و 15 ٪ نواة بذور المانجو وانخفض عدد خلايا heterophils ونسبة (H / L) heterophils / lymphocytes بشكل كبير مقارنة مع مجموعات الكنترول و 20 ٪. تحسنت معنويا الحالة المناعية حيث زاد الجلوبيولين ، IgG و IgM للكتاكيت التي تغذت على العلائق التي تحتوي على مستويات 10 ٪ ، 15 ٪. انخفض معنويا الكولسترول في البلازما بزيادة مستويات نواة بذور المانجو مقارنة مع مجموعة الكنترول. أيضا ، انخفض معنويا نشاط الكرياتينين كينز (CK) و دليل اكسدة الدهون (المالونالدهيد) لديوك الجميزه ، وسجل أدنى مستوى CK في 10 ٪ نواة بذور المانجو . لم يتأثر نشاط انزيمات الكبد (AST و ALT) باستخدام نواة بذور المانجو ، بينما انخفض معنويا نشاط انزيم الفوسفاتيز القلوي في الدم (ALP) بشكل كبير عندما غذيت الكتاكيت بعلائق تحتوي على 10 و 15 ٪ نواة بذور المانجو . انخفضت عدد البكتيريا الضارة في القناه الهضمية بزيادة مستويات نواة بذور المانجو . أيضا ، عدد البكتيريا الضارة في اللحوم الطازجة سواء الصدر اوالفخذ تناقص بزيادة مستويات نواة بذور المانجو . وأظهرت جميع مستويات نواة بذور المانجو المستخدمة كفاءة اقتصادية أفضل من مجموعة الكنترول وكانت افضلها 10 ٪ مقارنة بجميع المعاملات. كما أدى استخدام نواة بذور المانجو بمستوى 10 ٪ الى زيادة الكفاءة الاقتصادية النسبية ب 48 ٪ عن مجموعة الكنترول.

الخلاصة: نواة بذرة المانجو يمكن أن تستخدم بنسبة تصل إلى 10٪ كبديل جزئي للذرة دون أي تأثير سلبي على الأداء الانتاجى وخصائص الذبيحة بالإضافة إلى تحسين معايير الدم وزيادة الكفاءة الاقتصادية لديوك الجميزة خلال فترة النمو.