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SUBSTITUTE YELLOW CORN WITH SORGHUM IN STARTER AND GROWER DIET OF FAYOUMI CHICKS

By

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Abstract: *The present study was carried out at the Poultry Research Station, El-Azab, Fayoum, Egypt. The target of this investigation was designed to study and evaluate the profitable effects of replacing yellow corn (Y C) with different levels of sorghum grains (as a source of metabolizable energy, ME in the starter and the grower diets) on productive performance, slaughter characteristics, some blood hematological parameters and economical efficiency of the diets for the Fayoumi growing chicks. A total number of 225 unsexed one-week old Fayoumi chicks were used and this work lasted for 12 weeks. These chicks were randomly distributed equally to five experimental dietary treatments, in which, each experimental dietary treatment was equally subdivided into three replicates. Chicks were housed in battery brooders equipped with raised wire floors, and were reared under similar environmental, managerial and veterinarian conditions. At the beginning of first week of age, chicks were wing bands and weighed to obtain the initial live body weights. Both the starter and the grower diets were prepared where; sorghum grains substituted YC at graded levels, 0, 25, 50, 75 and 100%. The starter and the grower diets were formulated to be isonitrogenou, 19 and 15% CP, and isocaloric, almost 2900 kcal ME/kg diet, respectively. It could be concluded that, YC could be completely by sorghum grains in Fayoumi growing chicks without any obvious deterioration on the productive performance, blood hematological and carcass characteristics. While, replacing 75% YC with sorghum grains achieved the best economical efficiency and relative economical efficiency.*

INTRODUCTION

Dietary energy ingredients represent the major items in terms of quantity and cost of feed for livestock. The use of corn in livestock diets and

its use as an alternative fuel in ethanol production has increased demand for corn, necessitating the exploration of other energy sources for livestock diets (**Nyannor *et al.*, 2007**). In poultry rearing, 70% of recurring expenditure accounts for feed alone. The major energy source ingredient used is corn and the constant increase in the price and non availability of corn forces search for other course cereals as alternate energy sources which are available in plenty and cheaper, such as sorghum. Worldwide, sorghum grains crop is an important ingredient in poultry diets, and it has approximately 95% of the feeding value of corn (**Rooney, 1990**). Sorghum is a drought-tolerant crop and can be grown under a wider range of environmental conditions than corn (**Nyannor *et al.*, 2007**). Sorghum can replace corn as energy source without altering the performance of broilers (**Thakur *et al.*, 1985; Rama Rao *et al.*, 2002; Raju *et al.*, 2003**). In order to reduce the overdependence on corn, several

researchers have explored sorghum (**Mitzner *et al.*, 1994; Elkin *et al.*, 2002**) as suitable alternatives to corn in diets in various livestock species. Also, sorghum can be used in place of YC in broiler feeds with no obvious deterioration on economic efficiency. (**Oria *et al.* 1995**) mentioned that, the discovery of cultivars of sorghum with high in vitro protein digestibility, which may be comparable or superior to that of other cereal grains, can provide a viable alternative or complement to corn as the source of energy in poultry diets. Moreover, sorghum can be used in poultry feeding because of its nutritional content, the principal constituents of the sorghum grains are carbohydrates, proteins and lipids. Also it is found small quantity fibers, vitamins and minerals. Distinctly, sorghum is an anon-viscous grain where it contains 48 g/kg non-starch polysaccharide (NSP), including arabinoxylan, but only 4% of sorghum NSP is soluble (**Choct, 2006**). Lysine is one of the limiting amino acids in sorghum (**Bohoua and Yelakan, 2007**). It is evident that, the dominant protein fraction in sorghum is kafirin, which is a relatively poor source of digestible amino acids due to disulphide cross-linkages and low solubility. And, approximately 50% of sorghum protein consists of kafirin which is located in protein bodies in sorghum endosperm, where it is intimately associated with starch granules. The quantification of kafirin concentrations in sorghum is not straightforward (**Selle *et al.*, 2010**). However, sorghum grains were well studied to substitute for corn and contain potent antioxidants poliphenolic tannin (**Awika *et al.*, 2000**). Also, **El-Khalifa and El-Tinay (1994)** reported that, tannin and related phenolic compounds have strong antioxidant effects. Furthermore, the antioxidant and immunodulating of poliphenols in sorghum grains affect immune response by protecting against oxidative stress and lipid peroxidation, improving humoral and cellular immune response indicated by increase in B and T cell proliferation (**Bendich, 2004**). However, seed color is an inadequate indicator for tannin content in grain sorghum (**Boren and Waniska, 1992**).

The proposed investigation was designed to study and evaluate the profitable impact of substituting of YC with graded levels of sorghum grains, on the productive performance parameters, slaughter characteristics, some blood hematological parameters and economical efficiency of Fayoumi growing chicks.

MATERIALS AND METHODS

The present work was carried out at El-Azab Poultry Research Station, Fayoum, Egypt. This study was designed to investigate and evaluate the effect of substitute YC with graded levels of sorghum grains in the starter and grower diets of Fayoumi chicks on productive performance, carcass quality, some blood hematological parameters and economical efficiency of the diets. Total number of two hundred and twenty five, one-week old, Fayoumi chicks was engaged. The chicks were wing banded individually weighed, then they randomly equally distributed into five experimental dietary treatments of 45 chicks of each, and each experimental dietary treatment was also equally subdivided into three replicates. Chicks were reared in cleaned and fumigated battery brooders equipped with raised wire floors under similar environmental, managerial and hygienic conditions throughout all over the experimental period. The experimental diets were used during the growing period and lasted for 12 successive weeks. The experimental chicks (which were fed the starter diets) were switched to the grower diets at the beginning of the nine week. The

experimental diets of both starter and grower diets were formulated for meeting the requirements of the experimental chicks (Table, 1), according to **NRC (1994)**, and were prepared to be iso-nitrogenous, where the crude protein (CP) 19, 15%, and iso-caloric, where the metabolizable energy, 2900 ME/kg diet for both starter and grower diets, respectively. The experimental diets were five starter and five grower diets, where sorghum substituted YC at the graded levels, 0, 25, 50, 75, and 100%. Feed and water were offered ad libitum during the experiment period. Constant light was daily provided for 24 hours during the growing period. Throughout the studied growth period, individual live body weight (LBW) and feed intake (FI) values were recorded every two weeks for the different experimental dietary treatments. Then live body weight gain (LBWG), feed conversion (FC) and the total cost of feed were calculated. Hereupon, the experimental chicks were held without feed 12 h prior to termination of the present study, and, 3 male chicks from each experimental dietary treatment were randomly chosen for slaughter trait and the calculated values were expressed as a percentage of pre-slaughter LBW. After slaughter, head, viscera, shanks, liver, spleen, heart, and gizzard were removed, while the residual part weighed for determining the dressed weight that was included the carcass with wings. Blood sample were also collected from 3 birds for each experimental treatment in order to determine some blood hematological parameters (complete blood pictures and also to calculated blood indices). Economical efficiency and relative economical efficiency of the experimental diets were calculated according to input-output analysis. The obtained data across the experimental period were statistically analyzed according to **Steel and Torrie (1980)**, and the differences among means were compared by using Duncan's Multiple Range Test **(Duncan, 1955)**.

RESULTS AND DISCUSSION

Productive performance arameters:

The impact of substitute yellow corn with sorghum grains in the diets of the Fayoumi growing chicks on the final live body weight (LBW), live body weight gain (LBWG), feed intake (FI) and feed conversion (FC) are presented in Table, 2. Replacing yellow corn with sorghum grains in the diets of Fayoumi growing chicks appeared insignificant impact in LBW and LBWG among the dietary sorghum treatments, compared with the control group during the entire period (0-12 week). Overall, **Rama Rao *et al.*, (2001) and Travis *et al.*, (2006)** observed that, replacement of corn with sorghum did not reduce the body weight significantly. Additionally, nitrogen and gross energy concentrations of sorghum was higher than that of corn. Except for histidine and methionine, for which corn was higher than sorghum, concentration of the indispensable amino acids in the grains followed the same trend as that of nitrogen **(Adeola, 2006)**. So, the growing chicks which consumed diet-based 75% sorghum, gave the best LBW and LBWG values, followed by those fed diets-based 25% or 50% sorghum, respectively, while those fed diet-based 100% sorghum had the lowest value. **Reddy *et al.*, (2008)** concluded that, 50% replacement of corn with sorghum did not impair body weight and FCR of broiler, when compared to the corn based diet. Throughout the growth period (0-12 week of age), the effects of substituting yellow corn with sorghum grains in the diets of the Fayoumi growing chicks on feed intake (FI) and feed conversion (FC) were insignificant among the dietary sorghum treatments, comparing with the control group. The above-mentioned findings of productive

performance agreed with those reported by **Makled and Afifi (2001)** with broiler, **Ragab (2001) and Abd El-Hakim *et al.* (2003)** with quails, who reported that, YC could completely be substituted with sorghum without any adverse effects on performance parameters. In this respect, **Hala (1998)** and **El-Full *et al.*, (1998)** found that sorghum can completely substitute YC in broilers diet without any detrimental effects on LBW. Also, they detected that, neither significant nor consistent effects of substituting YC by sorghum on LBWG, FC. At last, **Yokozawa *et al.* (1998)** suggested that dietary tannin had a protective action against oxidative stress in rats. Also, the tannin fraction of sorghum grains has been reported to have antioxidant properties **(Yokozawa *et al.*, 2000)**. Reactive oxygen species react with biological molecules, destroying the structure of cells and eventually causing free-radical induced lipid oxidation. Moreover, tannins can prevent superoxide formation and have free-radical–scavenging activity, which can prevent lipid peroxidation **(Chung *et al.*, 1998).**

From the previous findings, it could be suggested that yellow corn applicably, could be completely substituted by sorghum without any detrimental effects on productive performance for the Fayoumi growing chicks.

Blood Hematology:

As a result of replacing yellow corn with sorghum grains in the diets of Fayoumi growing chicks, the finding of both hemoglobin concentration, RBCs, WBCs and thrombocytes count, revealed insignificant differences among the dietary treatments, comparing with the control group (Table, 3). These results displayed that, substitute YC with sorghum grains in the diets of Fayoumi growing chicks did not appear anemia symptoms, polycythemia, leukocytosis or leukopenia. In this respect, **Roath (1980), Mangrum (1975)** and **Clark *et al.* (2009)** indicated that, an inadequate number of RBC induces anemia, but if the RBCs count is increased beyond the normal limit the condition is termed polycythemia. Also, an increase of the WBCs count beyond the normal limit is referred to as leukocytosis, whereas the decrease below the lower limit is referred to as leukopenia. On other hand, the results of the differential of WBCs count, heterophiels %, lymphocytes %, monocytes % and eosinophiles%, showed significant differences. Moreover, **Stroev (1989)** reported that heterophiels and monocytes exhibit edantimicrobial activities. While, lymphocytes play an important part in the buildup of humoral and cellular immunities. However, the differences in blood indices, hematocrit %, mean cell volume and mean corpuscular hemoglobin among the experimental dietary treatments were insignificant, compared with control group. These findings explained that, substitute YC with sorghum grains in the diets of Fayoumi growing chicks was not displayed either any form of anemia symptoms or polycythemia or pseudopolycythemia for the chicks. Furthermore, **Mangrum (1975)** dissected that; the hematocrit is low whenever the RBC count and / or the hemoglobin are low. Hence the hematocrit is low in all forms of anemia, where the oxygenating capacity is decreased. A high hematocrit may be due to polycythemia or pseudopolycythemia. Moreover, **Makled and Afifi (2001)** reported that, feeding diet- based sorghum for broiler chicks did not significantly affect blood constituent's parameters.

Slaughter Test:

Replacing YC with sorghum grains at the theme levels in the diet of chicks did not affect edible parts, carcass, neck, liver, gizzard, heart, bursa and leg percentages (Table, 4). So, the insignificant changes in gizzard weights may explain that no changes in both of ability and function of digestion, this finding agreed with that of **(Al-Harthi, 2004)**. Distinctly, the profound increase in the relative weight of burse might indicate bursal activity which was supported by the

significant increase in haemagglutinin titers and reflected the stimulatory effect on the humoral branch of immunity (**Hamdy *et al.*, 2003**). However, there were significant differences in pre-slaughter weights (of the male chiccks) due to substitute YC with sorghum grains in the chick diets. And, the highest pre-slaughter weights percentage was observed with replacing 50% of YC by sorghum grains, while the least value of pre-slaughter percentage was found when 100% of YC was replaced by sorghum grains. Generally, replacing YC up to 75% with sorghum grains increased pre-slaughter percentage, comparing with the control group. However, substitute YC with sorghum grains in the diets of chicks reduced blood percentages. Whereas, replacing YC by sorghum grains in the diets of chicks increased spleen and head percentages. And, substitute 75% YC by sorghum grains in the diets of chicks gave the largest spleen and head percentage values. Also, replacing YC with sorghum grains in the diets of chicks increased both spleen and head percentages, compared with the control treatment which recorded the lowest values. Moreover, substitute 100% YC by sorghum grains in the diets of chicks, produced the greatest abdominal fat percentage, comparing with the other treatments. **Ragab (2001) and Abd El-Hakim *et al.* (2003)** concluded that, the sorghum grains could completely substitute YC in the diet of Japanese quail without any detrimental effect on slaughter parameters.

It could be suggested that, yellow corn aptly, could be completely substituted with sorghum without any adverse effects on carcass characteristics for Fayoumi growing chicks.

Economical Efficiency

The economical efficiency and relative economical efficiency of the various formulated diets were calculated according to both the market selling price of one-kg feed and the prevailing market selling price of one-kg gain in LBW. Regarding the economical point view, the findings in Table, 5 indicated that, replacing yellow corn% with sorghum grains in the diets of Faoumi growing chicks up to 75%, improved the economical efficiency and relative economical. And, substitute YC with sorghum grains at 75% level gave the highest economical efficiency and relative economical efficiency values, followed by the substitute yellow corn 50 and 25 % with sorghum grains. This may be attributed to the debasement in the total cost of feed, and also, may be due to amelioration for both FC and LBWG. While, substitute 100% YC with sorghum grains in the diets of Faoumi growing chicks recorded the lowest economical efficiency and relative economical efficiency values, compared with the other replacing percentages. Hereupon, there are considerable cost evaluating with substitute yellow corn up to 75% by sorghum grains, when compare with the control group. In this respect, **Hala (1998) and El- Full *et al.*, (1998)** found that, sorghum can be used in the diet of broilers at level up to 100% with no obvious deterioration of economical efficiency. From the above finding, it has been economically substituted YC with sorghum in the diet of Fayoumi growin chicks when, a shortage in corn crop is present or not available, and to alleviate the demand pressure on YC because of its fluctuated prices.

Regarding the above-mention findings, it could be defined that, YC appropriately, could be substituted with sorghum grains at 75% level in the diets of Fayoumi growing chicks, to get the best economical efficiency and relative economical efficiency, compared with the control diet (100% YC-based diet).

In conclusion, YC could be completely substituted by sorghum grains in Fayoumi growing chicks without any obvious deterioration on productive performance, blood hematological and

carcass characteristics. While, replacing 75% YC with sorghum grains had the best economical efficiency and relative economical efficiency.

Table (1): Composition and calculated analysis of starter and grower diets of Fayoumi growing chicks

Ingredients	Substitute yellow corn% with sorghum grains									
	Starter diets, %					Grower diets, %				
	0	25%	50%	75%	100%	0	25%	50%	75%	100%
Yellow corn	62.00	46.50	31.00	15.50	0.00	65.00	48.75	32.50	16.25	0.00
Sorghum	0.00	15.50	31.00	46.50	62.00	0.00	16.25	32.50	48.75	65.00
Soybean meal (44% CP)	21.56	21.38	21.00	20.02	18.92	17.96	16.78	15.57	14.40	13.19
Corn gluten (60%)	5.17	4.55	4.12	4.01	4.00	-	-	-	-	-
Bran	6.93	7.43	7.74	8.49	9.20	10.49	11.24	12.08	12.81	13.65
Vegetable oil	0.59	0.89	1.39	1.73	2.13	1.85	2.28	2.65	3. 09	3.46
Limestone	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00
Salt	0.35	0.35	0.35	0.35	0.35	0.30	0.30	0.30	0.30	0.30
Di calcium phosphate	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Premix*	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Dl-Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total (kg)	100	100	100	100	100	100	100	100	100	100
Calculated values**										
Crude protein %	19	19	19	19	19	15	15	15	15	15
ME, kcal/kg diet	2898	2886	2892	2888	2889	2896	2898	2896	2899	2896
Crude fiber %	3.74	3.78	3.80	3.83	3.84	3.84	3.86	3.88	3.90	3.92
Ether extract %	2.92	2.74	2.55	2.39	2.22	3.03	2.86	2.69	2.51	2.34
Calcium %	0.95	0.95	0.95	1.26	1.25	1.32	1.32	1.32	1.62	1.62
Available phosphorus %	0.49	0.48	0.46	0.45	0.43	0.48	0.47	0.45	0.44	0.42
Lysine %	1.03	1.00	0.93	0.89	0.90	0.80	0.76	0.65	0.61	0.65
Methionine	0.39	0.38	0.37	0.36	0.35	0.34	0.33	0.32	0.31	0.30
Diet cost/Ton, with L.E.▲	2529	2516	2510	2505	2502	2332	2330	2326	2324	2320

*Supplied per Kg of diet: vit. A, 12000 IU; vit. D3, 2200 IU; vit. E, 10mg; vit. K3 2mg; vit.B_1, 1mg; vit.B_2, 5mg; vit. B_6, 1.5mg; vit. B_{12}, 0.01mg; Nicotinic acid, 30mg; Folic acid, 1mg; Pantothenic acid, 10mg; Biotin, 0.05mg; Choline chloride, 500mg; Copper, 10mg; Iron, 30mg; Manganese, 60mg; Zinc, 50mg; Iodine, 1mg; Selenium, 0.1mg and Cobalt, 0.1mg. ** According to NRC (1994).

▲At time of experiment, with L. E., (Egyptian pound).

Table (2): Impact of substitute yellow corn with sorghum grains on live body weight (LBW), live body weight gain (LBWG), feed intake (FI) and feed conversion (FC), for Fayoumi growing chicks (mean S.E.)

Item	Week	Substitute yellow corn% with sorghum grains				
		0	25%	50%	75%	100%
LBW	0	62.03 ± 0.98	61.09 ± 0.97	61.40± 1.02	62.29 ± 1.05	61.92 ± 1.19
	2	121.86± 2.44^{bc}	117.81± 2.09^{c}	129.53± 3.05^{ab}	130.70± 3.11^{ab}	137.83± 4.08^{a}
	4	215.19± 4.79^{ab}	200.51± 5.16^{b}	215.37± 5.39^{ab}	219.37± 6.36^{a}	206.83± 7.76^{ab}
	6	361.89± 9.61	351.67± 7.66	368.56± 8.70	364.16± 10.17	352.13± 10.94
	8	503.10± 12.24	482.16± 10.81	504.71± 12.18	502.27± 14.04	491.58± 13.62
	10	687.39± 17.59	667.55± 19.03	697.22± 18.71	677.04± 19.96	667.39± 20.37
	12	892.48± 25.26	912.52± 27.30	895.93± 24.35	919.80± 27.90	885.23± 24.26
GAIN	0-2	57.88± 2.60^{b}	55.32± 1.93^{b}	68.13± 2.46^{a}	68.41± 2.63^{a}	75.91± 3.33^{a}
	0-4	150.46± 5.00^{ab}	139.42± 4.84^{b}	153.97± 4.90^{ab}	157.08± 5.92^{a}	144.92± 7.26^{ab}
	0-6	296.97± 10.19	290.12± 7.48	307.15± 8.36	301.86± 9.74	297.17± 16.19
	0-8	438.70± 12.90	420.82± 10.56	443.31± 11.81	439.98± 13.64	444.41± 21.89
	0-10	617.50± 19.61	606.23± 18.97	635.82± 18.49	614.76 ± 19.61	618.04± 31.18
	0-12	833.60± 29.44	851.30± 27.20	834.53± 24.14	857.51± 27.59	824.33± 36.07
FI	0-2	119.00± 0.00	119.00± 0.00	119.00± 0.00	119.00± 0.00	119.00± 0.00
	0-4	384.07± 8.87^{b}	399.00± 2.80^{a}	400.87± 0.93^{a}	409.73± 1.87^{a}	367.27± 3.73^{c}
	0-6	768.60± 16.80^{ab}	789.13± 6.07^{a}	740.60± 16.80^{b}	731.27± 9.33^{b}	772.80± 14.00^{ab}
	0-8	1376.67± 8.90	1376.67± 10.23	1367.33±15.64	1364.07± 17.90	1405.60± 6.10
	0-10	2072.93± 2.84^{b}	2107.47± 6.12^{ab}	2079.93± 22.17^{b}	2084.13± 17.73^{ab}	2125.67± 7.29^{a}
	0-12	2929.73± 14.05	2946.07± 8.90	2906.87± 23.85	2904.53± 15.95	2954.47± 7.64
FC	0-2	2.17±0.09^{a}	2.23± 0.08^{a}	1.87± 0.08^{b}	1.87± 0.08^{b}	1.64± 0.08^{b}
	0-4	2.69±0.09^{b}	3.06± 0.13^{a}	2.74± 0.10^{ab}	2.78± 0.11^{ab}	2.68± 0.15^{b}
	0-6	2.67± 0.10	2.79± 0.08	2.55± 0.09	2.53± 0.09	2.81± 0.15
	0-8	3.22± 0.10	3.36± 0.09	3.21± 0.09	3.22± 0.10	3.37± 0.18
	0-10	3.46± 0.12	3.60± 0.11	3.42± 0.10	3.53± 0.11	3.66± 0.18
	0-12	3.67±0.15	3.62± 0.13	3.63± 0.11	3.53± 0.11	3.75± 0.17

a and b, Means in the same row within the same item followed by different superscripts differ significantly P<0.05.

Table (3): Impact of substitute yellow corn with sorghum grains on some blood hematological parameters of males for Fayoumi growing chicks (mean ± S.E.).

Items	Substitute yellow corn% with sorghum grains				
	(The control) 0	25 %	50 %	75 %	100 %
Hemoglobin (Hb), g/100ml	11.00 ± 0. 46	10.57 ± 0.39	10.60 ± 0.32	11.07 ± 0.44	11.37 ± 0.38
Red Blood Cell (RBC), x 10^6 / ml	3.26 ± 0.32	2.93 ± 0.30	± 0. 19 2.84	3.34.± 0.29	3.37 ± 0.25
White Blood Cell (WBC), x 10^3 / ml	14.4 ± 0.35	12.67 ±1.95	13.4± 0.36	12.30 ± 0.44	13.43 ± 1.39
Thrombocytes count / ml	55.00 ± 9.45	47.00 ± 5.51	47.33 ± 4.41	49.00 ± 1.00	49.67 ± 4.48
Differential count:					
Heterophiels %	26.00 ± 2.65^{a}	23.00 ± 3.21$^{a b}$	18.00±1.00$^{a b}$	17.33 ±0.88^{b}	22.33± 3.18$^{a b}$
Lymphocytes %	± 2.40^{b} 65.33	70.67± 4.41^{ab}	73.33±0.88^{ab}	75.67±2.03^{a}	69.33±3.76^{ab}
Monocytes %	4.67±0.33$^{a b}$	4.33±0.33$^{a b}$	3.67± 0.33^{b}	5.00 ± 0.00^{a}	4.67± 0.33$^{a b}$
Eosinophiles %	4.00± 0.58$^{a b}$	3.33±0.33^{b}	5.00±0.58^{a}	3.33±0.33^{b}	3.67±0.33$^{a b}$
Basophiles %	0.00	0.00	0.00	0.00	0.00
Blast cells	0.00	0.00	0.00	0.00	0.00
Blood indices:					
Hematocrit (HCT) %*	39.33±2.67	38.00±2.65	37.33±2.03	41.00 ±1.53	40.67± 0.88
Mean cell volume (MCV), μ^3 (MCH), $\mu\mu$**	121.07± 4.47	130.63±4.88	131.93±7.78	123.80±6.65	121.70±6.59
Mean corpuscular hemoglobin (MCHI), (µg)***	34.07±2.17	36.57±2.61	37.43±1.42	33.40±1.81	33.90±1.32
Mean corpuscular hemoglobin concentration (MCHCI) %****	28.03±1.13	27.27±1.18	28.03±0.73	26.93±0.09	25.80±0.87

a and b, Means in the same row within the same item followed by different superscripts differ significantly P<0.05.

* When blood is centrifuged, the percentage occupied by the packed red blood cells is known as a hematocrit (HCT). HCT % = (packed RBC volume in sample / blood volume in the same sample) *100

** MCVI (nm) =% HCT X 10 / RBC (in millions / mm^3)

*** MCH I (µg) = Hb (g/dL) x 10 / RBC (millions / mm^3)

**** MCHCI % of normal = Hb (g / dL) x 100 / % HCT

*, **, ***, **** Cited by Mangrum (1975).

Table (4): Impact of substitute yellow corn with sorghum grains on carcass characteristics of males for Fayoumi growing chicks (mean ± S.E.).

Items	Substitute yellow corn% with sorghum grains				
	(The control) 0	25 %	50 %	75 %	100 %
1- Pre-slaughter weight, g	1040.33 ± 9.40 ^{cd}	1077.33 ± 25.01 ^{bc}	1167.67 ± 8.19 ^{a}	1110.67 ± 30.56 ^{ab}	986.00 ± 5.57 ^{d}
2- Blood %	3.79 ± 0.39 ^{a}	3.59 ± 0.33 ^{a}	± 0.36 ^{b} 1.74	2.10 ± 0.42 ^{b}	2.87 ± 0.49 ^{ab}
3- Feather %	8.29 ± 0.80	± 0.82 7.76	9.08 ± 0.50	8.26 ± 0.20	7.94 ± 0.63
4- Edible parts %	69.87± 1.34	69.98 ± 0.45	69.88 ± 0.62	70.03 ± 0.90	68.76 ± 56
5 -Carcass %	59.48 ± 0.78	56.94 ± 1.06	57.89 ± 0.90	57.72 ± 0.97	57.02 ± 0.85
6- Neck %	5.25 ± 0.71	6.05 ± 0.65	5.52 ± 0.38	6.12 ± 0.22	5.37± 0.12
7- Liver %	2.24 ± 0.10	2.45 ± 0.11	2.66 ± 0.25	2.45 ± 0.14	2.55 ± 0.39
8-Spleen %	0.28 ± 0.07 ^{b}	0.47 ± 0.04 ^{a}	0.36 ± 0.04 ^{ab}	0.31 ± 0.03 ^{ab}	0.42 ± 0.07 ^{ab}
9- Gizzard %	1.84 ± 0.46 ^{a}	2.57 ± 0.13 ^{a}	2.57 ± 0.35 ^{a}	2.56 ± 0.02 ^{a}	± 0.27 ^{a} 2.50
10- Heart %	0.56 ± 0.06	0.72 ± 0.07	0.61 ± 0.04	0.58 ± 0.04	± 0.03 0.59
11- Giblet %	4.92 ± 0.26 ^{b}	± 0.07 ^{a} 6.20	6.19± 0.55 ^{a}	5.90 ± 0.13 ^{ab}	6.05 ± 0.56 ^{ab}
12- Abdominal fat %	0.84 ± 0.04 ^{b}	0.76 ± 0.27 ^{b}	0.81 ± 0.29 ^{b}	0.52 ± 0.06 ^{b}	1.60 ± 0.29 ^{a}
13- Bursa %	0.29 ± 0.07	0.33 ± 0.03	0.16 ± 0.45	0.47± 0.11	0.28 ± 0.13
14- Head %	3.57 ± 0.11 ^{b}	4.54 ± 0.25 ^{a}	4.10 ± 0.22 ^{ab}	4.15 ± 0.44 ^{ab}	4.15 ± 0.27 ^{ab}
15- Legs %	5.00 ± 0.08	4.95 ± 0.17	5.04± 0.26	4.69 ± 0.10	4.55 ± 0.27

a, b, c and d, Means in the same row within the same item followed by different superscripts differ significantly P<0.05.

Table (5): Impact of substitute yellow corn with sorghum grains on economical efficiency (mean ± S.E).

Items		Substitute yellow corn% with sorghum grains				
		The control, 0	25 %	50%	75 %	100 %
Average feed intake (1-12 wks), kg/bird	(A)	2.93*	2.95**	2.91***	2.90****	2.95*****
Price / kg feed for the period from 0-8 and 8-12 wks (P.T.) •(B)		252.88 ^{S} 233.22 ^{SS}	251.58 ^{S} 232.99 ^{SS}	251.05 ^{S} 232.57 ^{SS}	250.47 ^{S} 231.50 ^{SS}	250.21 ^{S} 231.96 ^{SS}
Feed cost for 1-12 wks (P.T.) = A X B =	(C)	710.46	712.94	702.06	698.49	709.72
Average LBWG (kg/bird),	(D)	0.834	0.851	0.835	0.858	0. 824
Price / kg live body weight (P.T.), ••	(E)	1500	1500	1500	1500	1500
Total revenue (P.T.) = D X E =	(F)	1251	1276.5	1252.5	1287	1236
Net revenue (P.T.) = F – C =	(G)	540.54	563.56	550.44	588.51	526.28
Economic efficiency = (G / C) X 100 =	(H)	76.08	79.05	78.40	84.25	74.15
Relative economic efficiency = (H / H of the control, 0% restriction) X 100		100	103.04	103.05	110.74	97.46

•, ••According to the local market price at the experimental time.* The starter diet (1.38kg) + the grower diet, **The starter diet (1.38kg) + the grower diet (1.57), *** The starter diet (1.37kg) + the grower diet (1.54kg), ****The starter diet (1.36) + the grower diet (1.54), *****The starter diet (1.41 kg) + the grower diet (1.54 kg). ^{S} Price/kg of starter diet, ^{SS} Price/kg of grower diet.

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الملخص العربى

استبدال الذرة الصفراء بالذرة الرفيعة فى اعلاق كتاكيت بدارى الفيومى

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أجريت هذة الدراسه بمحطة بحوث الدواجن بالعزب – الفيوم – مصر ، بهدف دراسة وتقييم مدى كفاءة استبدال الذرة الصفراء بمستويات متدرجة من الذرة الرفيعة (كمصدر للطاقة المهضومه) فى الغذاء البادئ والنامى للكتاكيت الفيومى ، على الأداء الانتاجى و خصائص الذبيحة وبعض القياسات على الدم والكفاءة الاقتصادية. استخدم في هذا البحث ٢٢٥ كتكوت فيومى غير مجنس عمراسبوع ، قسمت عشوائياً الى خمس معاملات تجريبية غذائية متساوية العدد ، وكل معاملة وزعت على ثلاثة مكررات متساوية العدد ، وبعد توزيع تلك المعاملات على خمس بطاريات حضانة تم ترقيم كل طائر على حدى. غذيت الكتاكيت على خمس علائق تجريبية لكل من العلف البادى والنامى تم فيها استبدال الذرة الصفراء بخمسة مستويات من الذرة الرفيعة (صفر ، ٢٥ ، ٥٠، ٧٥ ، ١٠٠ ٪). كانت نسبة البروتين ومحتوى الطاقة فى علائق البادئ (١٩٪ ،٢٩٠٠ كيلو كالورى طاقة ممثلة / كجم ، على التوالى). بينما كانت نسبة البروتين ومحتوى الطاقة فى علائق النامى (١٥٪ ، ٢٩٠٠ كيلو كالورى طاقة ممثلة / كجم ، على التوالى). بدأت مرحلة البادئ من عمر اسبوع حتى ٨ اسابيع ، بينما استمرت فترة النامى حتى عمر التسويق (١٢ اسبوع). و قد تم عمل اختبار ذبح لدراسة الصفات النوعية لمكونات الذبيحة ، كما تم عمل صور كامله لعينات الدم المسحوبة تم فيها تقدير كل من تركيز الهيمو جلوبين وعدد كرات الدم الحمراء والبيضاءوالصفائح الدموية ، كما تم حساب دلائل الدم (Blood indices) . وكذلك تم عمل دراسة للكفاءة الاقتصادية ، لمقارنة تكلفة الغذاء والربحية بين جميع المعاملات التجريبية.

و من النتائج المستخلصة من هذة الدراسة و بعد تحليل البيانات احصائياً ، فأنة يوصى بالاتي: يمكن استبدال الذرة الصفراء تماماً بالذرة الرفيعة (السورجم) فى غذاء الكتاكيت الفيومى النامية ، بدون حدوث اى تأثيرت سلبيه على معايير الأداء الانتاجى و صفات الذبيحة وبعض القياسات على الدم. كما تبين أن إحلال ٧٥٪ من الذرة الصفراء بالذرة الرفيعة (السورجم) أعطى أفضل كفاءة إقتصاديه و أفضل كفاءة إقتصاديه نسبيه.