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TRITICALE GRAINS AS SUBSTITUTE FOR YELLOW CORN IN GROWING JAPANESE QUAIL DIETS

By

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Abstract: *The present study was conducted to evaluate the efficiency of partial substitution (0, 15, 30, 45 and 60%) of yellow corn (YC) with triticale grains (grown locally) in Japanese quail diets on productive performance, mortality rate and economical efficiency. A total number of 225 one week-old Japanese quail chicks were divided equally into five treatments (45 birds each), each treatment was equally subdivided into three replicates of 15 birds each.*

Results obtained could be summarized in the following:

1- Inclusion of triticale grains in the diets of Japanese quail at different levels caused a significant increase in live body weight (LBW) at 21, 28 and 35 days of age. Moreover, quails fed diet containing 45% triticale grains had significantly higher LBW values at 21, 28 and 35 days of age.

2- Inclusion of triticale grains in the diets of quail at different levels caused a significant increase in live body weight gain (LBWG) values during the periods from 15 to 21 and 7 to 35 days of age. Quails fed diet containing 45% triticale grains had higher LBWG values during the same periods.

3- Inclusion of triticale in the chick diets of quail at different levels caused significant differences in feed intake (FI) during all periods studied. Chicks fed diet containing 45% triticale had higher FI during the all experimental periods.

4- Inclusion of triticale grains in the diets of quail at different levels caused a significantly differences in feed conversion (FC), crude protein conversion (CPC) and caloric conversion ratio (CCR) values during the periods from 7 to 14, 15 to 21 and 29 to 35 days of age. Quails fed triticale grains diets had better FC, CPC and CCR values during the periods from 7 to 14 and 15 to 21 days of age.

5- Growth rate of quails fed triticale grains were significantly higher during the period from 7 to 35 days of age. Performance index of quails fed

triticale grains were significantly higher during the periods from 7 to 14 and 15 to 21 days of age. Mortality% appears that mortality of quails fed triticale grains were not related to treatments studied.

6- Inclusion of triticale grains in the Japanese quail diets at different levels caused a significant higher in hemoglobin, red blood cells count and hematocrit compared with control groups.

7- Feeding different levels of triticale grains insignificantly affected slaughter parameters of Japanese quails.

8- Economical efficiency values (from 7 to 35 days of age) was improved of quails fed all experimental diets containing triticale grain as compared with those fed the control diet.

***Generally,** it can be concluded that triticale grains can be substitute by YC in growing Japanese quail diets to get the best performance and the highest economical and relative efficiency.*

INTRODUCTION

Poultry production in Egypt has become one of the biggest agriculture industries and its improvement is one of the main objectives of both private and public sectors.

Feeding cost represents the major parts (about 60-70%) of total cost in poultry production. Yellow corn (YC) is the main source of energy in formulating poultry rations. Its price is increasing because of the limited world yield in covering the demands for both humans and livestock and using part of corn yield in production of bio ethanol. So, it is important to search for other alternative cheap energy sources which can solve this problem. Because it could, not only reduce the diet price but also produce cheaper meat and egg (by obtain a greater growth rate with lower cost) for human consumption and save the human food such as wheat and other cereals (**Abdelrahman *et al.*, 2008** and **Emam, 2010**).

Nontraditional feed grains, particularly from local producers, may offset some of the cost of feeding poultry by reducing transportation costs of commodities. In Egypt, the traditional feed grains, corn and soybeans, are not produced in quantities that make them available to poultry. Once identified, some nontraditional feed grains prove to be useful whereas others do not. Triticale is a relatively new feed grains (in Egypt) that is not used to any great degree in poultry feed (**Hermes and Johnson, 2004** and **Emam, 2010**).

Genetically, ***triticale*** (*X Triticosecale Wittmack*) is an amphiploid species stably baring the genomes of wheat (***Triticum*** sp.) and rye (***Secale*** sp.). By definition, the original or 'primary' triticales are the fertile, true-breeding progenies of an intergeneric hybridization, followed by chromosome doubling, between a seed parent from the genus Triticum and a pollen parent from the genus Secale **(FAO, 2010)**.

Triticale can grow well in some areas where wheat does not, disease resistance of wheat with the vigor, hardiness, and high lysine content of rye and some varieties can make more efficient use of water and soil nutrients. Triticale can provide ecological benefits by diversifying crop production, reducing pests, and protecting and improving soil by increasing organic matter. Triticale is an ideal crop for "organic" production methods. Triticale was found to be more efficient than wheat in utilizing and absorbing nitrogen from the soil. It also produced a 30% higher yield on acidic soils, and was superior to wheat on copper-deficient soil **(Myer and Barnett, 2000** and **Emam, 2010)**.

Almost three million hectare of triticale are grown today in the world. Triticale production has increased at an average rate of 150000 ton/year (an approximate 18% increase per year), reaching nearly 14 million ton in 2008 **(FAO, 2010)**. Although triticale is grown in many countries of the world, the major producers are in Europe. In 2008, approximately 92% of triticale was produced in Europe, 4% in Australia, 2% in Asia, 2% in Americas and zero% in Africa **(FAO, 2010** and **Emam, 2010)**.

A major concern regarding the use of non-traditional feed ingredients is that they contain a number of naturally occurring substances known as anti-nutritional factors (ANFs) that depress poultry performance when ingested in high levels. Triticale contains some known and perhaps unknown ANFs. The main ANFs in triticale are arabinoxylans, β-glucans, pentosans and cellulose. All of these have been found in small amounts in triticale, but at levels much lower than in rye.

With modern triticale, various ANFs, such as non-starch polysaccharides (pentosans) and protease inhibitors, while higher than in most other cereal grains, seem to have no effect on the growth performance of livestock consuming diets containing triticale grains **(NRC, 1989;** and **Emam, 2010)**.

Also, triticale-based diets may cause self-feeders to "gum-up" a little, in which case proper adjustment and frequent checking may be required. The problem can be minimized by mixing triticale with corn or grain sorghum; however, mixing triticale with wheat will not solve this problem **(Austin *et al.*, 1999** and **Emam, 2010)**.

The chemical composition of triticale grains as compared with those of YC reported by **NRC, 1994** are shown in Table 1. These studies showed that, triticale grains are a good source of protein (the protein content of triticale of 14.0%, which is about 1.64 times the protein of corn). On the other hand the energy content 3163Kcal/kg, which is about 0.94 times the energy of corn (Table 1).

Some studies demonstrated that triticale grains are a good source of protein and energy. For example, **Emam, (2010)** reported that triticale grains contain, 9.5, 12.50, 1.90, 4.30, 1.00, 70.80% and 3070.00 for moisture, crude protein (CP), ether extract (EE), crude fiber (CF), ash, nitrogen-free extract (NFE)% and MEn kcal/Kg, respectively. The energy content of modern triticale grains cultivars averages about 95 to 100% of that of maize or wheat for poultry and pigs **(NRC, 1998; Boros, 2002** and **Van Barneveld, 2002)**.

The amino acids and minerals% of triticale grains as compared with those of YC reported by **NRC, 1994** are shown in Table 1. These studies showed that, triticale grains are good source of amino acids especially lysine (the lysine content of triticale of 0.39%, which is about 1.5 times the lysine of corn) and minerals, especially the available phosphorus content of triticale of 0.1%, which is about 1.25 times the available phosphorus of corn, calcium content of triticale of 0.05%, which is about 2.50 times the calcium of corn and copper content of triticale of 8 mg/kg, which is about 2.67 times the copper of corn, **(NRC, 1994)**. Because of triticale's higher lysine and minerals, especially the phosphorus content, producers who mix their diets using a soybean meal-premix can save 100 Libra (lb) soybean meal (44%) and 5 lb dicalcium phosphate per ton of diet over comparable corn-based diets, which gives further advantage to producers who mix their own diets from "scratch"**(Myer and Barnett, 2000; Barnett *et al.*, 2006** and **Emam, 2010)**.

On the other hand, triticale is worth approximately 4 to 8% more than the purchase price of corn on an equal-weight basis because triticale not only replaces all of the corn in a typical poultry diet, but also part of the soybean meal (or other protein supplement), this may decrease dietary costs **(Varughese *et al.*, 1996 and Emam, 2010). Michela and Lorenz (1976)** reported that triticale's vitamin content is about the same as that of wheat.

Therefore, the objectives of the present study were to determine the efficiency of partial substitution of YC with triticale grains in growing Japanese quail diets on productive performance, mortality rate and economical efficiency.

MATERIALS AND METHODS

This study was carried out at the Poultry Research Station, El-Azab, Fayoum, Egypt during the period from March to April 2010. Chemical analyses were performed in the laboratories of the Poultry Research Station, Poultry Production Department, Faculty of Agriculture, Fayoum University.

The present study was conducted to evaluate the efficiency of partial substitution (0, 15, 30, 45 and 60%) of YC with triticale grains (grown locally) in Japanese quail diets on productive performance, mortality rate and economical efficiency. A total number of 225 one week- old Japanese quail chicks were divided equally into five treatments (45 birds each); each treatment was equally subdivided into three replicates of 15 birds each.

The experimental treatments were as follows:

1- Chicks were fed the control diet (D_1).

2- 15% YC in D_1 was substituted by triticale grains.

3- 30% YC in D_1 was substituted by triticale grains.

4- 45% YC in D_1 was substituted by triticale grains.

5- 60% YC in D_1 was substituted by triticale grains.

Chicks were initially fed a control diet for six days and its were individually weighed to the nearest gram at the start of experiment, wing-banded and randomly allotted to the dietary treatments. Chicks were raised in electrically heated batteries with raised wire mesh floors and had a free access to the mach feed and fresh water from nipple drinkers throughout the experiment. Light was provided for 23 h/d. Room temperature on day 0 was 33°C and decreased approximately 3°C per week until 21°C was reached, according to standard poultry rearing practices. Batteries were placed into a room provided with continuous fans for ventilation.

The tested raw material was analyzed for moisture, CP, ether extract (EE), CF, ash, NFE% and ME kcal/Kg*, by the methods outlined by Association of Official Analytical Chemists, **AOAC, (1990)**. The determined chemical analysis of triticale grains showed that triticale grains contained, 10.5, 12.30, 2.50, 4.70, 1.90, 68.10% and 3005.00 for moisture, CP, EE, CF, ash, NFE% and ME kcal/Kg*, respectively.

*The ME value was calculated according to **Janssen, 1989** by applying the equation: Triticale MEn (Kcal/kg)=(34.49×CP)+(62.16 × EE)+(35.61×NFE).

Diets were formulated (Table 2) to contain 24% CP and 2900 kcal ME/Kg diet and supplemented with minerals and vitamins mixture, DL-methionine and L-Lysine Hcl to cover the recommended requirements according to **NRC (1994)**.

Birds were individually weighed to the nearest gram at weekly intervals during the experimental period. At the same time, feed consumption was recorded and feed conversion (g feed/g gain) and body weight gain were calculated. Crude protein conversion (CPC), caloric conversion ratio (CCR) growth rate (GR), and performance index (PI) were also calculated **(Emam, 2010)**. Sex determination through plumage dimorphism (feather sexing) was done at 24 days of age.

At the end of the growing period (35 days of age), slaughter tests were performed using four males chicks around the average live body weight of each treatment. Birds were individually weighed to the nearest gram, and slaughtered by severing the jugular vein (Islamic method). After four minutes bleeding time, each bird was dipped in a water bath for two minutes, and feathers were removed by hand. After the removal of head, carcasses were manually eviscerated to determine some carcass traits, dressing% (eviscerated carcass without head, neck and legs) and total giblets% (gizzard, liver and heart). The eviscerated weight included the front part with wing and hind part. The bone of front and rear were separated and weighed to calculate meat percentage, the meat from each part was weighed and blended using a kitchen blender.

Individual blood samples were collected during exsanguinations, immediately centrifuged at 3500 rpm for 15 min. Serum was harvested after centrifugation of the clotted blood, stored at–20Ċ in the deep freezer until the time of chemical determinations. The biochemical characteristics of blood were determined colorimetrically, using commercial kits as previously described by **Emam (2010).** Accumulative mortality rate was obtained by adding the number of dead birds during the experiment divided by the total number of chicks at the beginning of the experimental period.

To determine the economical efficiency for the different dietary treatments, the amount of feed consumed during the entire experimental period was obtained and multiplied by the price of one Kg of each experimental diet which was estimated based upon local and international (international price was calculated using the world market price for triticale and maize in the year 2007 by Dollars ($) and converted to Egyptian Pound (£E) by multiplied by 5.51£E (the price $ during the experimental time according to the Central Bank of Egypt) **(Emam, 2010)**.

Statistical analysis of results was performed using the General Linear Models (GLM) procedure of the SPSS software **(SPSS, 1999)**, according to the follow general model:

$$Y_{ijk} = \mu + T_i + S_j + TS_{ij} + e_{ijk}$$

Where:

Y_{ijk}: observed value in the i_{th} treatment in the j_{th} sex effect of the k_{th} individual; μ: overall mean; T_i: treatment effect (**i**: 1 to 5); S_j: sex effect (**j**: female and male) ; TS_{ij}: interaction of treatment and sex effect and e_{ijk}: random error term. Treatment means indicating significant differences ($P \leq 0.01$ and $P \leq 0.05$) were tested using Duncan's multiple range test **(Duncan, 1955)**.

RESULTS AND DISCUSSION

Growth performance:

Results in Table 3 showed that inclusion of triticale grains in quail diets at different levels caused a significant ($P \leq 0.05$ and $P \leq 0.01$) increase in body weight (LBW) at 21, 28 and 35 days of age. Moreover, quails fed diet containing 45% triticale grains had higher LBW values at 21, 28 and 35 days of age (the improvement noted in market body weight has been attained due to an increase in feed consumption).While, there were insignificant effect on LBW ($P \geq 0.05$) at 7 and 14 days of age.

Data in Table 3 revealed no significant difference among dietary treatments in body weight gain (LBWG) values during the periods from 7 to 14, 22 to 28 and 29 to 35 days of age. Inclusion of triticale grains in quail diets at different levels caused a significant ($P \leq 0.01$) increase in LBWG values during the periods from 15 to 21 and 7 to 35 days of age. Quails fed diet containing 45% triticale grains had higher LBWG values during the same periods.

Numerically, inclusion of triticale grains in the diets increased LBW and LBWG at all ages studied compared with those fed the control diet. On the other hand, lower LBW and LBWG values were recorded with the quails fed the control diet (Table 3).

Results in Table 3 showed that inclusion of triticale in the chick diets at different levels caused significant ($P \leq 0.01$) differences in feed intake (FI) during all periods studied. Chicks fed diet containing 45% triticale had higher FI during the all periods studied, except the period from 7 to 14 days of age (Table 3). This result may be due to the high LBW and LBWG values recorded for this group during these periods. Generally, the FI was significantly increased with inclusion of triticale in the diets from 0 to 60% triticale grains when compared with those fed the control diet. This may give an indication that inclusion of triticale in the quail diets did not have a negative effect on diets palatability.Sex had an insignificant effect on LBW, LBWG and FI during all ages studied (Table 3).

Similar results were previously observed by **Yaqoob and Netke (1975)** who found that substituting triticale from maize, weight for weight, but not on an iso-nitrogenous basis, in a soybean oil meal diet, improved LBW and LBWG ($P \leq 0.05$) at 50% or more. Further more, **Al-Athari and Guenter (1988)** observed that diets containing 50 to 100% triticale resulted in higher ($P \leq 0.05$) LBW and LBWG (which is in harmony with our findings). **Janushonis *et al.* (2004)** indicated that average LBW and LBWG was higher when maize was replaced with triticale and supplemented with enzymes in the diets of turkey broiler at the rate of 25 to 35%. Also, **Chapman *et al.* (2005)** indicated that LBW and LBWG for the diets using triticale was five percent higher than for the corn-based diet. Recently, **Emam (2010)** indicated that average LBW and LBWG was higher when YC was replaced with triticale grains and supplemented with enzymes in the diets of broiler at the rate of 25 to 100%.

In this respect, other researchers agreed with our results by reporting non-detrimental effect of triticale in poultry feeding trials. **Johnson and Eason (1988)** observed that growth of broiler chickens was similar whether triticale or wheat was main the cereal source in diets that contained 50% cereal and were equalized for nutrient content. Also, **Vieira *et al.* (1995)** and **Attia and Abd Elrahman (2001)** found that the graded inclusion of triticale up to 40% as substitute for YC had no negative effect on LBW and LBWG of broilers. **Al-Athari and Al-Bustany (1997)** reported that inclusion of triticale up to 20% with 40% corn did not cause any significant effect on LBW and LBWG when compared with the control (60% corn), which agreed with our findings.

Similarly, with broiler chickens, LBW and LBWG did not differ significantly ($p \geq 0.05$) among the wheat/triticale based diets **(Hermes and Johnson, 2004** and **Korver *et al.*, 2004)**. Also, **Abdelrahman *et al.* (2008)** demonstrated that inclusion of triticale in the broiler diets at different levels caused a significant reduction in LBW and LBWG during the starter period, but not during the finishing and overall periods. In the contrast, **Proudfoot and Hulan (1988)** reported that complete replacement of wheat in broiler diets with triticale decreased LBW and LBWG to market weight (which disagreed with our findings).

These results are in harmony with those obtained by **Al-Athari and Guenter (1988)** and **Abdelrahman *et al.* (2008)** who reported that the FI were significantly increased with inclusion of triticale in the broiler diets. Recently, **Emam (2010)** indicated that the FI were significantly increased when YC was replaced with triticale grains and enzymes in the diets of broiler at rate of 25 to 100%.

However, with broiler chickens, FI, did not differ significantly among the wheat/triticale or corn/triticale based diets (**Azmal *et al.*, 2001** and **Korver *et al.*, 2004**). While, these results disagree with those of **Janushonis *et al.* (2004)** who indicated that the FI in the experimental groups was lowest when maize was replaced by triticale and supplemented with enzymes in the diets of turkey broilers at the rate of 25 to 35%.

Data in Table 4 revealed no significant difference among dietary treatments in feed conversion (FC), crude protein conversion CPC and caloric conversion ratio (CCR) values during the periods from 22 to 28 and 7 to 35 days of age. Inclusion of triticale grains in the diets at different levels caused a significantly ($P \leq 0.05$ and $P \leq 0.01$) differences in FC, CPC and CCR values during the periods from 7 to 14, 15 to 21 and 29 to 35 days of age. Quails fed triticale grains diets had better FC, CPC and CCR values during the periods from 7 to 14 and 15 to 21 days of age. Numerically, quails fed triticale grains diets had better FC, CPC and CCR values during the period from 7 to 35 days of age when compared with those fed the control diet, on the other hand, worst values of FC, CPC and CCR were recorded with the quails fed the control diet during the periods from 7 to 14, 15 to 21 and 7 to 35 days of age (Table 4). Sex had an insignificant effect on FC, CPC and CCR during all ages studied (Table 4).

These results are in harmony with those obtained by **Ruiz *et al.* (1987)** who determined that feed efficiency was significantly better for chicks fed triticale than for those fed corn. **Abdelrahman *et al.* (2008)** observed that FCR were significantly improved by inclusion of triticale in the broiler diet during the finishing and overall period when compared with the control diet. Recently, **Emam (2010)** reported that inclusion of triticale in the broiler diets at rate of 25 to 100% improved FC and CPC during the finisher and overall periods compared with those fed the control diet but the difference is not significant

No significant differences among efficiencies of FC when increasing proportions of the maize of a broiler diets were replaced by triticale (**Rao *et al.*, 1976**; **Vohra *et al.*, 1991** and **Azmal *et al.*, 2001**). However, other researchers have observed poorer FCR with triticale-based diets in broilers. Reduction from 4-5% in average FCR for broilers fed triticale compared with the control diet was found by **Vieira *et al.* (1995)**. Moreover, **Al-Athari and Al-Bustany (1997)** reported a significant lower FCR when chicks were fed a diet containing 40.6% triticale with 19.2% corn when compared with the control group. Also, **Korver *et al.* (2004)** found that birds fed diets containing the triticale grains had the worst FCR compared with those fed the wheat diets.

Our results agreed with **Al-Athari and Guenter (1988)** who reported that diets containing 50 to 100% triticale resulted in better energy and protein efficiencies compared with the wheat control diet. However, this finding disagreed with other researchers who reported non-detrimental effect of triticale in poultry feeding. **Yaqoob and Netke (1975)** for example. demonstrated that substituting triticale for maize, weight for weight, but not on an iso-nitrogenous basis, in a groundnut oil cake starter diet did not affect the protein efficiency ratio when the substitution exceeded 75%.

Growth rate (GR), performance index (PI) and mortality rate%:

Inclusion of triticale grains in the diets at different levels caused a significantly ($P \leq 0.05$) differences in GR values during the periods from 15 to 21 and 7 to 35 days of age. Growth rate of quails fed triticale grains were significantly higher during the period from 7 to 35 days of age when compared with those fed the control diet, but did not differ when compared with the other triticale groups (Table 5).

Results in Table 5 indicated that feeding different levels of triticale grains insignificantly affected PI during the periods from 22 to 28, 29 to 35 and 7 to 35 days of age. it significantly ($P \leq 0.05$) affected PI values during the periods from 7 to 14 and 15 to 21 days of age. Performance index of quails fed triticale grains were significantly higher during these periods when compared with those fed the control diet, but did not differ when compared with the other triticale groups (Table 5). Numerically, quails fed triticale grains diets had higher GR and PI values during the period from 7 to 35 days of age when compared with those fed the control diet, on the other hand, lower values of GR and PI were recorded with the quails fed the control diet during the period from 7 to 35 days of age (Table 5).

Concerning sex effect (Table 5), females had significantly higher GR ($P \leq 0.05$) than males only during the period from 15 to 21 days of age. Sex had an insignificant effect on PI during all ages studied (Table 5).

Similar results were observed by **Yaqoob and Netke (1975)** who reported that the growth obtained with a triticale- groundnut oil cake diet was higher than with the maize- groundnut oil cake diet. Recently, **Emam (2010)** reported that inclusion of triticale in the broiler diets at different levels (from 25 to 100%) caused a significant improve in GR and PI during the finisher and overall periods compared with those fed the control diet.

Johnson and Eason (1988) observed that growth of broiler chickens was similar whether triticale or wheat was the main cereal source in diets that contained 50% cereal and were equalized for nutrient content. Also, **Hermes and Johnson (2004)** found that feeding broiler chicks triticale up to 15% with corn did not affect their performance. **Abdelrahman *et al.* (2008)** demonstrated that triticale can be substituted for corn in broiler diets up to 50% of the corn grain without any adverse effect on chicks performance.

Elsewhere. poultry feeding studies showed that diets containing up to 30% or 40% triticale had no negative effect on performance **(Belaid, 1994** and **Vieira *et al.*, 1995)**. Also, other studies with broilers and egg production showed no differences in productivity, even when diets consist of 100% triticale **(Fayez *et al*, 1996** and **Boros, 1999)**.

Results in Table 5 indicated that the percentage of mortality was 4.44% in quails fed diet containing 45% triticale grains, however, the percentage of mortality was 2.22% in quails fed the other experimental diets (from 7 to 35 days). It appears that mortality% was not related to treatments studied.

Blood constituents:

Some blood constituents analyses are summarized in Table 6. Inclusion of triticale in the Japanese quail diets at different levels caused a significant ($P \leq 0.05$) differences in hemoglobin (HGB), red blood cells count (RBC's) and hematocrit (HCT). while, insignificant ($P \geq 0.05$) effects were observed in the other blood constituents being white blood cells count (WBC's), total leucocytes (TLC), all differential count% (neutrophils, lymphocyte (LYMP), monocytes, eosinophil (ESINO), basophil (BASO) and blast cells) and blood index (mean cell volume (MCV), MCH and MCHC%)

The HGB, RBCs and HCT were found to be significantly ($P \leq 0.05$) lower in chicks fed the control diet compared with the other groups. However, the HGB, RBCs and HCT were higher for chicks fed triticale compared with the control group, this may be due to the high level of copper in triticale grains (which is about 2.67 times the copper of corn, Table 1). Numerically, partial substitution of corn with triticale grains improves MCV, MCH and MCHC% when compared with those fed the control diet but the difference is not significant (Table 6).

Slaughter parameters:

Results in Table 7 indicated that feeding different levels of triticale grains insignificantly affected slaughter parameters of Japanese quails. Numerically, partial substitution of corn with triticale grains increased front part, front meat, rear meat, carcass weight after evisceration and dressing% when compared with those fed the control diet but the difference is not significant (Table 7).

Similar results were observed by **Rao *et al.* (1976)** who reported that there were no significant differences among carcass weights as percentages of LBW and relative weights of either liver or gizzard when increasing proportions (0, 25, 50 or 75%) of the maize of a broiler diets were replaced by triticale. Also, **Charalambous *et al.* (1986)** observed that carcass yield, carcass plus edible giblets yield and dressing percentage were higher in birds fed corn or corn/triticale diets than in broiler fed a diet with triticale as the only cereal grain. Elsewhere, **Korver *et al.* (2004)** reported that feeding triticale to broiler had a negative effect on eviscerated carcass weight and many portion weights.

Abdelrahman *et al.* (2008) reported that there was a significant higher percentage of breast meat in chicks fed 25% triticale compared with the control and 50% triticale, but no difference observed between control and 50% triticale. The LBW, liver, total giblets and half rear were found to be significantly lower in chicks fed the control diet compared with other groups and there were no significant differences between all groups in term of dressing and abdominal fat percentages, compared with other groups.

Economical efficiency (EEf):

A: By using average locale market price:

Results in Table 8 showed that EEf values during the period from 7 to 35 days of age was improved of quails fed all experimental diets containing triticale grain as compared with those fed the control diet. Chicks fed diet containing 15% triticale grains had the best economical and relative efficiency values being 4.49 and 106.06%, respectively followed by chicks fed diet containing 30% triticale grains (4.46 and 105.25%, respectively) then chicks fed diet containing 60% triticale grains (4.41 and 104.16%, respectively) then chicks fed diet containing 45% triticale grains (4.30 and 101.59%, respectively) when compared with the control group.

B: By using average international market price:

Results in Table 8 showed that EEf values during the period from 7 to 35 days of age improved in chicks fed all experimental diets as compared with those fed the control diet. Chicks fed diet containing 60% triticale grains had the best economical and relative efficiency values being 4.58 and 108.94%, respectively followed by chicks fed diet containing 30% triticale grains (4.53 and 107.60%, respectively) then chicks fed diet containing 15% triticale grains (4.51 and 107.23%, respectively) then chicks fed diet containing 45% triticale grains (4.42 and 105.06%, respectively) when compared with the control group.

These results are in harmony with those obtained by **Belaid (1994)** who showed that in economic studies of broiler and layer, the inclusion of triticale leads to cost savings resulting from the complete replacement of maize and from a considerable reduction of soybean meal in the diets. The study found cost reductions from using triticale ranged from 1.3 to 2.3% for broiler diets when triticale was priced equal to corn. When triticale was priced at 95% of corn, these cost reductions were 4.5 to 7.2% for broiler diets.

Triticale would be an economically feasible replacement for wheat in broiler diets when its price is less than or equal to 95% of the cost of wheat. This information is important to broiler producers where triticale is produced and is available for inclusion in poultry diets. The drought tolerance of triticale may make it an attractive option for broiler production when the availability of wheat is limited and wheat prices are elevated due to drought or other conditions **(Korver *et al.*, 2004)**. Also, **Chapman *et al.* (2005)** reported that triticale is also more cost-effective than its competitors (e.g. wheat, corn, barley and millet), as its high lysine content means less protein supplements are required and this is in accordance with results reported by **Emam (2010)**.

Generally, it can be concluded that triticale grains can be substitute by YC in growing Japanese quail diets to get the best performance and highest economical and relative efficiency. Triticale may make an attractive option for Japanese quail production when the availability of YC is limited and YC prices are elevated due to drought or other conditions.

Table 1: Proximate chemical composition, amino acids and minerals of triticale grains (TG) as compared with yellow corn (YC).

Items	NRC, 1994		TG/YC*
	TG	YC	
Chemical composition			
Dry matter%	90.00	89.00	101.12
Crude protein%	14.00	8.50	164.71
Ether extract%	1.50	3.80	39.47
Crude fiber%	4.00	2.20	181.82
ME kcal/Kg	3163	3350	94.42
Amino acids%			
Histidine	0.26	0.23	113.04
Isoleucine	0.39	0.29	134.48
Leucine	0.76	1.00	76.00
Lysine	0.39	0.26	150.00
Methionine	0.26	0.18	144.44
Cystine	0.26	0.18	144.44
Phenylalanine	0.49	0.38	128.95
Tyrosine	0.32	0.30	106.67
Threonine	0.36	0.29	124.14
Tryptophan	0.14	0.06	233.33
Valine	0.51	0.40	127.50
Arginine	0.57	0.38	150.00
Minerals			
Potassium%	0.36	0.30	120.00
Calcium%	0.05	0.02	250.00
Available Phosphorus%	0.10	0.08	125.00
Iron mg/kg	44.00	45.00	97.78
Zinc mg/kg	32.00	18.00	177.78
Copper mg/kg	8.00	3.00	266.67

*Assuming chemical composition, amino acids and minerals of the YC equals 100.

Table 2: Composition of the experimental diets.

Items, %	Level of yellow corn substitution%				
	0	15	30	45	60
Yellow corn, ground	55.00	46.75	38.50	30.25	22.00
Triticale, ground	0.00	8.25	16.50	24.75	33.00
Soybean meal (44%CP)	35.00	35.00	35.00	35.00	35.00
Corn gluten meal	6.00	5.50	5.00	4.40	3.90
Calcium carbonate	1.50	1.50	1.50	1.50	1.50
Sodium chloride	0.30	0.30	0.30	0.30	0.30
Vit. and Min. premix [1]	0.30	0.30	0.30	0.30	0.30
Di-calcium phosphate	1.00	1.00	1.00	1.00	1.00
Vegetable oil [2]	0.60	1.10	1.60	2.20	2.70
DL–Methionine	0.10	0.10	0.10	0.10	0.10
L-Lysine Hcl	0.20	0.20	0.20	0.20	0.20
Total	100.0	100.0	100.0	100.0	100.0
Calculated analysis [3]%:					
Crude protein	24.04	24.04	24.05	23.99	23.99
Ether extract	3.12	3.50	3.88	4.36	4.74
Linoleic acid	1.76	191	2.07	2.27	2.43
Crude fiber	3.74	3.94	4.14	4.34	4.54
Calcium	0.96	0.96	0.96	0.96	0.96
Available phosphorus	0.33	0.33	0.33	0.33	0.33
Methionine	0.50	0.50	0.50	0.50	0.50
Methionine+Cystine	0.89	0.89	0.90	0.89	0.89
Lysine	1.34	1.35	1.35	1.36	1.36
ME, kcal./Kg	2911	2909	2907	2910	2908
Cost (£.E./ton) [4]	2235.8	2225.8	2215.8	2203.8	2193.8
Relative cost [5]	100.0	99.55	99.11	98.57	98.12

[1]Each 3.0 Kg of the Vit. and Min. premix manufactured by Agri-Vet Company, Egypt and contains : Vit. A, 12000000 IU; Vit. D_3 2000000 IU; Vit. E, 10 g; Vit. K_3, 2.0 g; Vit. B1, 1.0 g; Vit. B2, 5 g; Vit. B6, 1.5 g; Vit. B12,10 mg; choline chloride, 250 g; biotin, 50 mg; folic acid, 1 g; nicotinic acid , 30 g; Ca pantothenate, 10 g; Zn, 50 g; Cu,10 g; Fe, 30 g; Co, 100 mg; Se, 100 mg; I, 1 g; Mn, 60 g and anti-oxidant, 10 g, and complete to 3.0 Kg by calcium carbonate.

[2] Mixture from 75% soybean oil and 25% sunflower oil.

[3] According to NRC, 1994.

[4] According to the local market price at the experimental time.

[5] Assuming the price of the control group equal 100.

Table 3: Effects of triticale grains as substitute for yellow corn (YC) in growing Japanese quail diets on live body weight (LBW, g), live body weigh gain (LBWG, g) and feed intake (FI, g).

Items		Level of YC substitution%					Overall Mean	Sex effect	
		0	15	30	45	60		Female	Male
Live body weight (LBW, g)									
Age / days	7	16.55±0.33[1]	16.25±0.33	16.51±0.33	16.61±0.37	16.55±0.33	16.49±0.15	16.39±0.24	16.60±0.18
	14	34.58±1.06	36.48±1.08	35.98±1.08	36.45±1.20	36.06±1.05	35.91±0.49	35.81±0.78	36.01±0.58
	21	$65.52^{b}\pm1.90$	$70.47^{ab}\pm1.94$	$68.58^{b}\pm1.94$	$74.81^{a}\pm2.20$	$70.75^{ab}\pm1.89$	70.20±0.89	71.21±1.41	69.20±1.07
	28	$108.70^{C}\pm2.5$	$116.56^{AB}\pm2.5$	$113.76^{BC}\pm2.5$	$121.59^{A}\pm2.7$	$118.03^{AB}\pm2.5$	115.84±1.2	116.24±1.9	115.44±1.4
	35	$149.75^{C}\pm2.5$	$157.40^{AB}\pm2.5$	$154.38^{BC}\pm2.5$	$162.61^{A}\pm2.7$	$159.79^{AB}\pm2.6$	157.20±1.2	158.57±1.9	155.83±1.5
Live body weigh gain (LBWG, g)									
Age period / days	7-14	18.03±0.89	20.23±0.91	19.47±0.91	19.84±1.01	19.51±0.88	19.42±0.41	19.42±0.66	19.41±0.49
	15-21	$30.94^{C}\pm1.21$	$33.55^{BC}\pm1.20$	$32.94^{BC}\pm1.23$	$37.84^{A}\pm1.30$	$34.84^{AB}\pm1.20$	34.30±0.57	35.40±0.91	33.20±0.68
	22-28	43.19±1.20	46.12±1.20	45.18±1.22	46.78±1.29	46.82±1.20	45.57±0.57	45.03±0.91	46.10±0.69
	29-35	41.05±1.30	41.22±1.31	40.62±1.31	41.02±1.39	41.06±1.35	41.24±0.62	41.39±0.98	40.55±0.75
	7-35	$133.17^{C}\pm2.4$	$141.15^{AB}\pm2.4$	$137.89^{BC}\pm2.4$	$145.87^{A}\pm2.6$	$143.38^{AB}\pm2.5$	140.74±1.1	142.19±1.8	139.30±1.4
Feed intake (FI, g)									
Age period / days	7-14	$47.60^{A}\pm0.15$	$45.61^{D}\pm0.15$	$43.40^{E}\pm0.16$	$46.20^{C}\pm0.16$	$46.90^{B}\pm0.15$	45.95±0.07	45.98±0.12	45.92±0.09
	15-21	$75.62^{B}\pm0.51$	$74.66^{B}\pm0.50$	$74.09^{B}\pm0.52$	$79.80^{A}\pm0.52$	$75.46^{B}\pm0.50$	75.83±0.24	75.54±0.39	76.13±0.29
	22-28	$109.4^{E}\pm0.62$	$120.4^{B}\pm0.61$	$112.9^{D}\pm0.62$	$125.3^{A}\pm0.62$	$118.0^{C}\pm0.61$	117.19±0.29	117.07±0.46	117.31±0.35
	29-35	$129.8^{D}\pm0.41$	$127.2^{E}\pm0.40$	$132.9^{C}\pm0.41$	$146.3^{A}\pm0.41$	$144.3^{B}\pm0.40$	136.11±0.19	136.17±0.31	136.04±0.23
	7-35	$362.4^{D}\pm0.92$	$367.8^{C}\pm0.90$	$363.2^{D}\pm0.93$	$397.6^{A}\pm0.93$	$384.7^{B}\pm0.90$	375.07±0.43	374.75±0.69	375.40±0.52

[1] Mean ± standard error of the mean.

a, …b, and A…. E. values in the same row within the same item followed by different superscripts are significantly different (at $P \leq 0.05$ for a to b ; $P \leq 0.01$ for A to E).

Table 4: Effects of triticale grains as substitute for yellow corn (YC) in growing Japanese quail diets on feed conversion (FC), crude protein conversion (CPC) and caloric conversion ratio (CCR).

Items		Level of YC substitution%					Overall Mean	Sex effect	
		0	15	30	45	60		Female	Male
Feed conversion (FC)									
Age period / days	7-14	$1.74^{a}\pm0.11^{1}$	$2.22^{b}\pm0.11$	$2.48^{ab}\pm0.11$	$2.41^{b}\pm0.11$	$2.47^{ab}\pm0.11$	2.45±0.05	2.39±0.08	2.51±0.06
	15-21	$2.56^{A}\pm0.09$	$2.35^{AB}\pm0.09$	$2.25^{B}\pm0.09$	$2.16^{B}\pm0.10$	$2.19^{B}\pm0.09$	2.29±0.04	2.26±0.07	2.33±0.05
	22-28	2.59±0.07	2.66±0.07	2.60±0.07	2.70±0.08	2.53±0.07	2.62±0.03	2.62±0.05	2.61±0.04
	29-35	$3.24^{C}\pm0.11$	$3.14^{C}\pm0.11$	$3.38^{B}\pm0.11$	$3.71^{A}\pm0.11$	$3.61^{AB}\pm0.11$	3.40±0.05	3.34±0.08	3.45±0.06
	7-35	2.76±0.05	2.63±0.05	2.68±0.05	2.75±0.05	2.72±0.05	2.70±0.02	2.67±0.04	2.73±0.03
Crude protein conversion (CPC)									
Age period / days	7-14	$0.623^{a}\pm0.02$	$0.525^{b}\pm0.02$	$0.572^{ab}\pm0.02$	$0.566^{ab}\pm0.02$	$0.595^{a}\pm0.02$	0.574±0.01	0.563±0.02	0.585±0.01
	15-21	$0.601^{A}\pm0.02$	$0.554^{AB}\pm0.02$	$0.543^{B}\pm0.02$	$0.519^{B}\pm0.02$	$0.510^{B}\pm0.02$	0.542±0.01	0.528±0.01	0.556±0.01
	22-28	0.623±0.02	0.640±0.02	0.615±0.02	0.649±0.02	0.608±0.02	0.627±0.01	0.630±0.01	0.624±0.01
	29-35	$0.779^{C}\pm0.03$	$0.756^{C}\pm0.03$	$0.814^{AB}\pm0.03$	$0.891^{A}\pm0.03$	$0.891^{A}\pm0.03$	0.822±0.01	0.813±0.02	0.831±0.02
	7-35	0.663±0.01	0.632±0.01	0.645±0.01	0.660±0.01	0.655±0.01	0.649±0.01	0.641±0.01	0.656±0.01
Caloric conversion ratio (CCR)									
Age period / days	7-14	$7.98^{a}\pm0.31$	$6.35^{b}\pm0.32$	$7.20^{ab}\pm0.31$	$7.00^{b}\pm0.31$	$7.07^{b}\pm0.31$	7.08±0.15	6.90±0.24	7.26±0.17
	15-21	$7.66^{a}\pm0.30$	$6.83^{ab}\pm0.30$	$6.80^{ab}\pm0.31$	$6.27^{b}\pm0.32$	$6.37^{b}\pm0.30$	6.75±0.14	6.57±0.23	6.92±0.17
	22-28	7.55±0.21	7.73±0.21	7.55±0.21	7.86±0.21	7.34±0.21	7.60±0.10	7.62±0.16	7.59±0.12
	29-35	$9.43^{C}\pm0.31$	$9.14^{C}\pm0.31$	$9.83^{BC}\pm0.31$	$10.8^{A}\pm0.33$	$10.5^{AB}\pm0.32$	9.88±0.15	9.71±0.23	10.1±0.18
	7-35	8.02±0.15	7.64±0.15	7.79±0.15	7.99±0.16	7.91±0.15	7.84±0.07	7.75±0.11	7.93±0.09

[1] Mean ± standard error of the mean.

a, …b. and A,… C. values in the same row within the same item followed by different superscripts are significantly different (at $P \le 0.05$ for a to b ; $P \le 0.01$ for A to C).

Table 5: Effects of triticale grains as substitute for yellow corn (YC) in growing Japanese quail diets on growth rate (GR), performance index (PI) and mortality rate%.

Items		Level of YC substitution%					Overall Mean	Sex effect	
		0	15	30	45	60		Female	Male
Growth rate (GR)									
Age period / days	7-14	0.697±0.02[1]	0.759±0.02	0.718±0.02	0.740±0.02	0.733±0.02	0.729±0.01	0.734±0.02	0.725±0.01
	15-21	0.614^{b}±0.02	0.626^{b}±0.02	0.632^{b}±0.02	0.682^{a}±0.02	0.649^{ab}±0.02	0.645±0.01	0.661^{a}±0.01	0.630^{b}±0.01
	22-28	0.499±0.01	0.501±0.01	0.500±0.01	0.481±0.01	0.498±0.01	0.494±0.01	0.483±0.01	0.505±0.01
	29-35	0.323±0.01	0.305±0.01	0.307±0.01	0.291±0.01	0.301±0.01	0.306±0.01	0.309±0.01	0.303±0.01
	7-35	1.60^{b}±0.01	1.63^{a}±0.01	1.61^{ab}±0.01	1.63^{a}±0.01	1.63^{a}±0.01	1.62±0.003	1.62±0.005	1.62±0.004
Performance index (PI)									
Age period / days	7-14	1.38^{b}±0.11	1.87^{a}±0.11	1.72^{a}±0.11	1.80^{a}±0.12	1.57^{ab}±0.11	1.66±0.05	1.68±0.09	1.65±0.06
	15-21	2.84^{b}±0.18	3.27^{ab}±0.17	3.32^{ab}±0.18	3.62^{a}±0.18	3.53^{a}±0.18	3.33±0.08	3.44±0.13	3.23±0.10
	22-28	4.45±0.19	4.50±0.18	4.65±0.19	4.56±0.20	4.87±0.19	4.61±0.09	4.63±0.14	4.60±0.11
	29-35	4.86±0.18	5.11±0.18	4.75±0.18	4.59±0.19	4.62±0.19	4.82±0.08	4.95±0.13	4.70±0.10
	7-35	3.39±0.11	3.75±0.11	3.63±0.11	3.63±0.12	3.72±0.12	3.65±0.05	3.75±0.09	3.56±0.07

Mortality rate %

Items	Level of YC substitution %				
	0	15	30	45	60
Total number of chicks at the beginning of Exp.	45	45	45	45	45
Number of dead birds	1	1	1	2	1
Mortality%	2.22	2.22	2.22	4.44	2.22

[1] Mean ± standard error of the mean.

a, …b, values in the same row within the same item followed by different superscripts are significantly different (at $P \leq 0.05$ for a to b).

Table 6: Effects of triticale grains as substitute for yellow corn (YC) in growing Japanese quail diets on some blood parameters.

Items		Level of YC substitution%					Overall Mean
		0	15	30	45	60	
Hemoglobin (g/dL)		$5.50^{b}\pm1.304^{1}$	$12.05^{a}\pm1.30$	$13.45^{a}\pm1.30$	$9.35^{ab}\pm1.30$	$12.80^{a}\pm1.30$	10.63±0.58
Red blood cells ($10^{\wedge6}$/ ML)		$0.87^{b}\pm0.25$	$2.23^{a}\pm0.25$	$2.50^{a}\pm0.25$	$1.81^{a}\pm0.25$	$2.50^{a}\pm0.25$	1.98±0.11
White blood cells ($10^{\wedge6}$/ ML)		18.85±1.66	18.55±1.66	18.55±1.66	19.90±1.66	19.15±1.66	19.00±0.74
Total leucocytes/cmm		99.50±19.8	115.0±19.8	186.0±19.8	97.00±19.8	160.5±19.8	131.7±8.89
Differential count%	Neutrophils	30.50±3.62	31.00±3.62	26.00±3.62	34.00±3.62	30.50±3.62	30.40±1.62
	Lymphocyte	61.50±3.95	60.50±3.95	65.50±3.95	57.00±3.95	60.50±3.95	61.00±1.77
	Monocytes	4.00±0.55	4.00±0.55	5.50±0.55	5.00±0.55	5.50±0.55	4.80±0.25
	Eosinophils	4.00±0.55	4.50±0.55	3.00±0.55	4.00±0.55	3.50±0.55	3.80±0.25
	Basophils	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
	Blast cells	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Blood index	HCT%	$15.20^{b}\pm5.16$	$46.45^{a}\pm5.16$	$49.60^{a}\pm5.16$	$35.30^{a}\pm5.16$	$47.75^{a}\pm5.16$	38.86±2.31
	MCV μ^3	169.9±19.4	209.2±19.4	198.2±19.4	195.1±19.4	192.2±19.4	192.89±8.68
	MCH µµg	68.45±5.36	54.15±5.36	53.60±5.36	51.60±5.36	51.25±5.36	55.81±2.40
	MCHC%	46.20±7.73	25.90±7.73	27.00±7.73	26.45±7.73	26.70±7.73	30.45±3.46

[1] Mean ± standard error of the mean.

a, …b, values in the same row within the same item followed by different superscripts are significantly different (at $P \leq 0.05$ for a to b).

Table 6: Effects of triticale grains as substitute for yellow corn (YC) in growing Japanese quail diets on some blood parameters.

Items		Level of YC substitution%					Overall Mean
		0	15	30	45	60	
Hemoglobin (g/dL)		$5.50^{b}\pm1.304$[1]	$12.05^{a}\pm1.30$	$13.45^{a}\pm1.30$	$9.35^{ab}\pm1.30$	$12.80^{a}\pm1.30$	10.63±0.58
Red blood cells ($10^{\wedge6}$/ ML)		$0.87^{b}\pm0.25$	$2.23^{a}\pm0.25$	$2.50^{a}\pm0.25$	$1.81^{a}\pm0.25$	$2.50^{a}\pm0.25$	1.98±0.11
White blood cells ($10^{\wedge6}$/ ML)		18.85±1.66	18.55±1.66	18.55±1.66	19.90±1.66	19.15±1.66	19.00±0.74
Total leucocytes/cmm		99.50±19.8	115.0±19.8	186.0±19.8	97.00±19.8	160.5±19.8	131.7±8.89
Differential count%	Neutrophils	30.50±3.62	31.00±3.62	26.00±3.62	34.00±3.62	30.50±3.62	30.40±1.62
	Lymphocyte	61.50±3.95	60.50±3.95	65.50±3.95	57.00±3.95	60.50±3.95	61.00±1.77
	Monocytes	4.00±0.55	4.00±0.55	5.50±0.55	5.00±0.55	5.50±0.55	4.80±0.25
	Eosinophils	4.00±0.55	4.50±0.55	3.00±0.55	4.00±0.55	3.50±0.55	3.80±0.25
	Basophils	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
	Blast cells	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Blood index	HCT%	$15.20^{b}\pm5.16$	$46.45^{a}\pm5.16$	$49.60^{a}\pm5.16$	$35.30^{a}\pm5.16$	$47.75^{a}\pm5.16$	38.86±2.31
	MCV μ^3	169.9±19.4	209.2±19.4	198.2±19.4	195.1±19.4	192.2±19.4	192.89±8.68
	MCH μμg	68.45±5.36	54.15±5.36	53.60±5.36	51.60±5.36	51.25±5.36	55.81±2.40
	MCHC%	46.20±7.73	25.90±7.73	27.00±7.73	26.45±7.73	26.70±7.73	30.45±3.46

[1] Mean ± standard error of the mean.

a, ...b, values in the same row within the same item followed by different superscripts are significantly different (at $P \leq 0.05$ for a to b).

Table 7: Effects of triticale grains as substitute for yellow corn (YC) in growing Japanese quail diets on slaughter parameters.

Items	Level of YC substitution%					Overall Mean
	0	15	30	45	60	
Live body weight (g)	154.50±2.86[1]	156.75±2.86	157.00±2.86	157.25±2.86	158.75±2.86	156.85±1.28
Intestinal length (cm)	55.50±2.27	56.25±2.27	52.75±2.27	56.00±2.27	56.25±2.27	55.35±1.02
Blood & feather%	8.95±0.89	8.04±0.89	7.79±0.89	9.06±0.89	7.47±0.89	8.26±0.40
Leg%	2.40±0.10	2.51±0.10	2.36±0.10	2.24±0.10	2.21±0.10	2.43±0.05
Head%	5.10±0.14	5.01±0.14	5.22±0.14	4.88±0.14	4.96±0.14	5.04±0.06
Neck%	3.12±0.28	3.10±0.28	3.50±0.28	3.31±0.28	3.29±0.28	3.26±0.13
Heart%	0.81±0.09	0.94±0.09	0.84±0.09	0.89±0.09	0.86±0.09	0.87±0.04
Liver%	2.17±0.17	2.17±0.17	1.93±0.17	2.16±0.17	2.17±0.17	2.12±0.07
Gizzard%	1.85±0.14	1.74±0.14	1.81±0.14	1.79±0.14	1.81±0.14	1.80±0.06
Total giblets%	4.83±0.26	4.84±0.26	4.59±0.26	4.84±0.26	4.85±0.26	4.79±0.12
Front part%	39.73±0.88	42.02±0.88	41.46±0.88	40.60±0.88	42.80±0.88	41.32±0.39
Rear part%	25.43±0.60	24.82±0.60	25.55±0.60	25.61±0.60	25.06±0.60	25.29±0.27
Front meat%	81.39±0.82	82.84±0.82	84.41±0.82	84.69±0.82	84.36±0.82	83.54±0.37
Rear meat%	82.11±1.18	81.98±1.18	84.03±1.18	84.09±1.18	83.65±1.18	83.17±0.53
Carcass weight after evisceration%	66.12±1.19	67.80±1.19	67.83±1.19	66.92±1.19	68.86±1.19	67.51±0.53
Dressing%	70.95±1.20	72.64±1.20	72.42±1.20	71.76±1.20	73.71±1.20	72.29±0.54

[1] Mean ± standard error of the mean.

Table 8: Effects of triticale grains as substitute for yellow corn (YC) in growing Japanese quail diets on economical efficiency (EEf) (using average local and international market price).

Items	Using average local market price					Using average international market price				
	Level of YC substitution%					Level of YC substitution%				
	0	15	30	45	60	0	15	30	45	60
a	0.3624	0.3678	0.3632	0.3976	0.3847	0.3624	0.3678	0.3632	0.3976	0.3847
b	223.58	222.58	221.58	220.38	219.38	224.79	221.8	218.81	215.62	212.64
a*b=c	81.025	81.865	80.478	87.623	84.395	81.464	81.578	79.472	85.731	81.803
d	0.1332	0.1412	0.1379	0.1459	0.1434	0.1332	0.1412	0.1379	0.1459	0.1434
e	3184.7	3184.7	3184.7	3184.7	3184.7	3184.7	3184.7	3184.7	3184.7	3184.7
d*e=f	424.11	449.52	439.14	464.55	456.62	424.11	449.52	439.14	464.55	456.62
f-c=g	343.08	367.66	358.66	376.93	372.23	342.64	367.94	359.67	378.82	374.82
g/c	4.2343	4.4910	4.4567	4.3017	4.4105	4.2061	4.5103	4.5257	4.4188	4.5820
r	100.00	106.06	105.25	101.59	104.16	100.00	107.23	107.60	105.06	108.94

Average feed intake (Kg/bird) a
Price / Kg feed (P.T.) b .... (Based on average local and international market price of diets during the experimental time).
Total feed cost (P.T.) = a x b = c
Average LBWG (Kg/ bird) d
Price / Kg live weight (P.T.) e..................................(according to the local market price at the experimental time).
Total revenue (P.T.) = d x e = f
Net revenue (P.T.) = f - c = g
Economical efficiency = (g /c).............................(net revenue per unit feed cost).
Relative efficiency r ....(assuming that economical efficiency of the control group (1) equals 100).

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الملخص العربي

إستبدال الذرة الصفراء بحبوب التريتيكال في علائق السمان الياباني النامي

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اجريت التجربة لدراسة تقيم أستبدال جزء من حبوب الأذرة بنسبة (صفر، ١٥، ٣٠، ٤٥ و ٦٠%) بحبوب التريتكال وتأثيرها على الأداء الأنتاجي ومعدل النفوق والكفاءة الأقتصادية للسمان الياباني النامي. استخدم عدد ٢٢٥ كتكوت عمر ٧ أيام قسمت إلي ٥ معاملات (٤٥ طائر /معاملة) كل معاملة تشتمل علي ٣ مكررات و١٥ طائر بكل مكرر.

وتتلخص النتائج المتحصل عليها فيما يلي:-

١- كان هناك زيادة معنوية في وزن الجسم الحي علي أعمار ٢١ و٢٨ و٣٥ يوم من العمر نتيجة لاحتواء العليقة علي مستويات مختلفة من حبوب التريتيكال. كانت أعلي زيادة معنوية في وزن الجسم الحي للسمان المغذي علي عليقة تحتوي علي ٤٥% تريتيكال علي أعمار ٢١ و٢٨ و٣٥ يوم من العمر.

٢- كان هناك زيادة معنوية في معدل الزيادة في وزن الجسم الحي خلال الفترات ١٥ إلي ٢١ و ٧ إلي ٣٥ يوم من العمر نتيجة لاحتواء العليقة علي مستويات مختلفة من حبوب التريتيكال. كانت أعلي زيادة معنوية في معدل الزيادة في وزن الجسم الحي للسمان المغذي علي عليقة تحتوي علي ٤٥% تريتيكال خلال الفترات ١٥ إلي ٢١ و ٧ إلي ٣٥ يوم من العمر.

٣- كان هناك زيادة معنوية في كمية الغذاء المأكول خلال كل الفترات نتيجة لاحتواء العليقة علي مستويات مختلفة من حبوب التريتيكال. كانت أعلي زيادة معنوية في كمية الغذاء المأكول للسمان المغذي علي عليقة تحتوي علي ٤٥% تريتيكال خلال كل الفترات المدروسة.

٤- كان هناك زيادة معنوية في كفاءة تحويل الغذاء و البروتين و الطاقة خلال الفترات ٧ إلي ١٤ و١٥ إلي ٢١ يوم من العمر نتيجة لاحتواء العليقة علي مستويات مختلفة من حبوب التريتيكال. كانت أعلي زيادة معنوية في كفاءة تحويل الغذاء والبروتين والطاقة للسمان المغذي علي عليقة التريتيكال خلال الفترات ٧ إلي ١٤ و١٥ إلي ٢١ يوم من العمر.

٥- كان هناك زيادة معنوي في معدل النمو نتيجة لتغذية السمان علي حبوب التريتيكال خلال الفترة من ٧ إلي ٣٥ يوم. كان هناك زيادة معنوي في دليل الأداء الإنتاجي نتيجة لتغذية السمان علي حبوب التريتيكال خلال الفترات من ٧ إلي ١٤ ومن ١٥ إلي ٢١ يوم من العمر. كانت نسبة النفوق نتيجة لتغذية السمان علي حبوب التريتيكال غير مرتبطة بالمعاملات التجريبية.

٦- كان هناك زيادة معنوي في الهيموجلوبين وعدد كرات الدم الحمراء ونسبة المكونات الخلوية نتيجة لتغذية السمان علي حبوب التريتيكال عند مقارنتها بمجموعة الكنترول.

٧- لم يكن هناك أي تأثير معنوي علي صفات الذبيحة نتيجة لتغذية السمان علي حبوب التريتيكال.

٨- كانت أعلي كفاءة اقتصادية ونسبية سواء باستخدام متوسط أسعار الأسواق المحلية أو العالمية خلال الفترة من ٧ إلي ٣٥ يوم من العمر للسمان المغذي علي علائق التريتيكال عند مقارنتها بتلك المغذاة علي عليقة الكنترول.

الأستنتاج: يمكن إحلال حبوب التريتيكال بديلا عن الذرة الصفراء حتى ٦٠% في علائق السمان الياباني النامي للحصول علي أحسن أداء إنتاجي وأعلي كفاءة اقتصادية ونسبية.