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THE USE OF *TRITICALE* AS ALTERNATIVE CEREAL GRAIN TO YELLOW CORN IN LAYING HENS DIET

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ABSTRACT

An experiment was conducted to study the nutritional value of *triticale* grains, using one hundred forty four Mandarah laying hens divided into 4 groups. Four isonitrogenous (16% CP) and isocaloric (2700 Kcal/kg) experimental diets were formulated. The control diet contained yellow corn as a main source of energy, while *triticale* was incorporated into the other three diets instead of yellow corn at replacement ratio of 50, 75, or 100%, respectively. These experimental diets were fed to their respective hen groups during the period from 30 to 42 weeks of age. The results obtained could be summarized as follows:

1. Even though the results were; to some extent, in favour of group of hens fed the diet in which 75% of yellow corn was replaced by *triticale*, it could be concluded that triticale can economically be used to replace yellow corn completely in diets for local Mandarah laying hens, with no adverse effect on their performance for egg production and feed conversion.
2. With the exception of producing a lower yolk color score, dietary *triticale* had no deleterious effect on egg quality; as measured by egg weight, egg components percentage, Haugh units score, and eggshell quality measurements.
3. Fertility of eggs was improved, but hatchability of fertile eggs was not affected by dietary *triticale*.
4. No significant differences were observed among hen groups in the concentrations of plasma total protein, total lipids, albumin, or globulin. Yet, significant differences existed in plasma cholesterol level, but not related to dietary *triticale*.
5. No significant differences were detected among treatments in nutrients digestibility; as evidenced by digestion coefficients of organic matter, crude protein, ether extract, and nitrogen-free extract. Even though significant differences were found in crude fiber digestibility, it is of little importance as a nutrient for poultry.

Keywords: Triticale, nutritive, value, laging hens.

INTRODUCTION

In practical poultry feeds, the chief source of energy is yellow corn. Other cereal grains could be substituted for yellow corn in poultry diets; when their availability and prices become competitive with yellow corn. *Triticale* is one of the other cereal grains which resulting from the intergeneric cross between durum wheat and rye. It was reported that it has a higher protein

content than that of either parent (Homer and Philip, 1981). *Triticale* is an artificial genus created by scientists in an attempt to produce a new cereal with a new combination of characteristics which will outperform present-day cereal crops, at least under certain economical conditions (Zillinsky and Borlaug, 1971). *Triticale* can be cultivated in new reclaimed areas due to its resistance to draft and most of wheat diseases. Compared to wheat *triticale* had also higher productivity (McDonal *et al*., 1987). Villegas *et al*. (1970) studied 25 varieties and crosses of *triticale* and found that the protein content varied from 10.1 to 19.3% with a mean of 15 percent. The lysine content of the protein varied from 2.32 to 3.42 g per 16 g of nitrogen with a mean of 2.96. Obviously, in feeding comparisons even against a common standard, quite different results may be obtained depending upon the protein content and amino acid availability of the *triticale* studied.

Allee (1974) suggested that *triticale* is inferior to corn and superior to barley, and that the metabolizable energy value of *triticale* for poultry has been reported to be similar to that of wheat. McNab and Shannon (1975) concluded that *triticale* was a better carbohydrate source for the chicken than either wheat or rye. *Triticale* is an intergeneric cross between wheat and rye. It grows well in temperate climates, often gives a higher yield than wheat and has a higher protein content than most wheats. The metabolizable energy level is similar to that of wheat. Digestibility of *triticale* is similar to or higher than the digestibility of wheat. Diets containing 30% replacing wheat or corn on an isonitrogenous and isocaloric basis, produced no adverse effect on growth or efficiency of feed utilization (Scott *et al*., 1982). Omar (1985) reported that *triticale* can be successfully used in both broiler and layer diets. However, the use level must be adjusted to the nutrient level of that particular grain. The present work was undertaken to facilitate the use of *triticale* in laying hen diets as alternative cereal grain. The response to different dietary *triticale* levels and its effects on egg production, egg quality, digestibility, some blood parameters and economic efficiency were investigated in this experiment.

MATERIALS AND METHODS

This study was conducted at Sakha Poultry Research Station; affiliated to Animal Production Research Institute; Kafr El-Sheikh Governorate, from 6 August to 11 November, 1997 to evaluate the use of *triticale* as an energy source instead of yellow corn in diets for laying hens.

1.Experimental birds and diets:

One hundred forty four hens and twelve cocks of 30 weeks old and average body weight of 1576 g were taken from Mandarah breeding stock and divided randomly into 4 groups of 3 replicates, of 12 hens and one cock each. The birds were housed in flour pens, kept under similar managerial, hygienic, and environmental conditions, and fed the experimental diets during the period from 30 to 42 weeks of age.

Triticale was incorporated into the experimental diets to replace 0, 50, 75 or 100% of yellow corn in the control diet. The experimental diets were formulated to fulfill the requirements of laying hens for the major nutrients (NRC, 1994). Diets were isonitrogenous and isocaloric of about 16% crude protein and 2750 Kcal/kg, respectively. The experimental diets were offered *ad libitum*, while fresh water was available all times. The compositions and chemical analyses of the experimental diets as well as those of *triticale* and yellow corn are shown in Tables (1 and 2).

Table 1: Composition and chemical analysis of the experimental diets.

Ingredients	Triticale as a percent of yellow corn in the experimental diets			
	0%	50%	75%	100%
Yellow corn	65.750	32.875	16.437	---
Triticale	---	32.875	49.313	65.75
Soybean meal 44%	22.4	18.50	16.60	14.50
Wheat bran	2.40	1.95	1.65	1.05
Limestone	6.31	5.90	5.90	5.90
Dicalcium phosphate	1.09	1.50	1.59	2.15
Bone meal	1.50	1.50	1.50	1.00
Premix*	0.30	0.30	0.30	0.30
Sunflower oil	---	1.33	2.644	3.586
L-lysine	---	---	0.10	0.15
Clean sand	---	3.02	3.716	5.364
Common salt	0.25	0.25	0.25	0.25
Total	100	100	100	100
Nutrient composition (calculated):				
CP %	16.03	16.53	16.80	16.93
ME, Kcal/kg	2733	2696	2746	2732
CF %	3.35	3.60	3.70	3.80
Calcium %	3.20	3.10	3.10	3.10
Total phosphorus %	0.70	0.80	0.80	0.80
Lysine %	0.83	0.84	0.86	0.89
Methionine %	0.28	0.26	0.25	0.24
Methionine + cystine	0.53	0.53	0.53	0.53
Price / ton, L.E.	708.52	688.29	740.74	712.36

***: One kg of premix contained 3.3 × 10^6 IU vit. A; 3.3 gvit. E; 3.3 × 10^6 IU vit. D_3; 0.33 g vit. K; 0.33g vit B_1; 1.33 g vit. B_2; 6.67 g vit. B_5; 0.50 g vit. B_6; 33 g vit. B_{12}; 3.3 g Pantothenic acid; 0.33 g Folic acid; 16.67 mg Biotin; 166.67 g Choline; 1 g Copper; 10 g Iron; 13.3 g Mn; 0.1 g Iodine; 0.03 g Se and Carrier, $CaCO_3$ to 1 kg.**

2.Measurements:

The change in body weight of birds and feed intake was determined. Data on the performance of hens for egg production, feed conversion and egg weight were recorded throughout the experimental period.

At 38, 40 and 42 weeks of age, a total of 84 eggs (7 eggs from each replicate) were randomly chosen and used for egg quality measurements. Egg quality was assessed by weight of egg and its components (Amer, 1972), egg shape index and yolk index (Romanoff and Romanoff, 1949), yolk color index using the Roche color fan, Haugh units (Haugh, 1937), shell

thickness, and shell weight per unit of surface area (SWUSA) according to Carter (1975).

Table 2: The chemical composition of experimental diets on DM basis %.

Treatments and cereal grains	DM %	OM	CP	EE	CF	Ash	NFE
Experimental diets							
Control, yellow corn	89.61	91.57	18.17	3.13	3.63	8.43	66.64
50% triticale	89.46	89.95	16.80	3.79	4.63	10.05	64.73
75% triticale	88.75	88.89	16.32	6.45	6.14	11.11	59.98
100 %triticale	87.96	88.21	15.75	7.32	7.86	11.79	57.28
Cereal grains							
Triticale	87.80	96.80	13.58	3.05	6.22	3.12	74.03
Yellow corn	90.57	98.28	9.64	3.59	2.30	1.72	82.75

Eggs were also collected for 7 days, starting at 37, 39 and 41 weeks old for 3 times during the experimental period to measure the reproductive efficiency (fertility and hatchability).

Eggs were held in a holding room (about 15 ^{o}C and 80% RH) during each week until placed in chick master incubator. Eggs were candled at the 18th of incubation to remove infertile eggs and eggs containing dead embryos. Fertility was expressed as the number of fertile eggs relative to the number of total eggs set in the incubator. Hatchability of fertile eggs was expressed as the number of normal hatched chicks relative to the number of fertile eggs.

Blood samples were collected at the end of the experiment (42 weeks of age) from the wing vein of 9 birds from each treatment in heparinized tubes and centrifuged at 3000 rpm for 15 min. and the plasma was obtained and kept at –20 ^{o}C until analysis. The concentrations of plasma total proteins, albumin, total lipids, and cholesterol were determined calorimetrically using commercial kits (provided by β-Scientific Office for Laboratory Chemicals, Mansoura, Egypt) in Sakha Animal Production Laboratory, Animal Production Research Institute. Plasma globulin was calculated by the difference between plasma total protein and albumin, since the fibrinogen usually comprises a negligible fraction (Sturkie, 1976).

At 42 weeks of age a digestibility trial was conducted using three mature cocks from each group. The cocks were kept individually in metabolic cages and fed on their respective experimental diets for a preliminary period of 7 days to become adjusted to cages. Then followed by a 5-day collection period during which excreta were collected and feed intake was recorded.

The excreta were then dried in a forced air oven at 65 ^{o}C for 48 hours. Excreta were allowed to equilibrate in moisture with the air before being weighed, finally ground and stored in plastic bags for analysis.

Representative samples of the experimental diets and studied cereal grains and excreta were taken and prepared for analysis using the conventional methods of Association of Official Analytical Chemists (A.O.A.C., 1980). The faecal nitrogen was determined following the

procedure outlined by Jakobsen *et al*. (1960). Urinary organic matter (UOM) was calculated according to Abou Raya and Galal (1971).

3.Economic efficiency:

Economic efficiency of the experimental diets was calculated from the input-output analysis based upon the differences in both egg out-put and feeding cost (Heady and Jensen, 1954). The costs of veterinary services, housing and labor were not included, as they are the same for all groups.

4.Statistical analysis:

The obtained data were analyzed by the analysis of variance (Snedecor and Cochran, 1967). Duncan's multiple range test was used for comparison among the means (Duncan, 1955).

Computations of the data were performed using MSTATC computer program package (Russell, 1986).

The following Models were used for studied traits:

$X_{ijk} = U + T_I + e_{ijk}$

Where:

X_{ijk} = Any observation.

U = The overall mean.

T_I = Effect of triticale level (i = 1, 2 and 4).

e_{ijk} = Random error.

RESULTS AND DISCUSSION

1.The performance of experimental laying hens:

Data on the performance of Mandarah laying hens for egg production, egg weight and feed conversion are summarized in Table 3.

Results obtained indicated that the change in body weight of the experimental groups during the entire experimental period showed no significant differences due to *triticale* level in the diets. The results showed that complete substitution of triticale for yellow corn in the diets of laying hens had no negative effect on their body weight. Lesson and Summers (1987), Tima *et al*. (1989) and Richter and Lemser (1994) found also similar results with laying hens.

It is apparent that, the values of feed consumption (g/hen/day) were nearly similar for birds fed the control diet and 50%-*triticale*-diet, while those fed a diet containing 75% or 100% *triticale* instead of yellow corn consumed less amounts of feed. This could be due to the presence of anti-nutritional factors in *triticale* such as trypsin inhibitor and pentosans which are known to impair feed consumption and feed conversion of birds when the intake of any reaches certain level (Madi and Tsen, 1974 and Attia and Abd El-Rahman, 1996). No significant differences were detected, however, in daily feed intake among groups due to dietary *triticale* level. This result is in agreement with those reported by Tima *et al.* (1989), Castanon *et al*. (1990) and Azman *et al*. (1997) who concluded that triticale in laying hens diet had no negative effect on feed consumption.

Table 3: Effect of feeding experimental diets on the performance of laying hens.

Parameters	Triticale as a percent of yellow corn in the experimental diets			
	0%	50%	75%	100%
Live weight gain; g	109.7 ±10.71	149.0 ±10.76	149.3 ±13.04	105.3 ±49.13
Egg production; egg/hen	57.75 ±0.75	55.82 ±1.04	58.39 ±1.39	56.00 ±0.96
Hen-day egg production (H.D%)	63.46 ±0.83	61.34 ±1.14	64.16 ±1.20	61.54 ±1.05
Egg weight; g	42.28 ±0.28	47.29 ±0.31	47.55 ±0.34	46.96 ±0.31
Egg mass; g/wk	210.08 ±3.08	203.51 ±4.60	213.96 ±4.78	202.53 ±4.05
Daily feed consumption (g/hen)	133.77 ±3.86	127.92 ±3.52	117.67 ±2.049	120.36 ±3.17
Feed conversion (g feed/g egg)	4.46 ±0.13	4.44 ±0.12	3.88 ±0.08	4.19 ±0.11

It is apparent that the total egg production during the entire period elapsed between 30 and 42 weeks of age were 57.75, 55.82, 58.39 and 56.00 eggs/hen for groups fed the control diet (0.0%) and those fed diets containing 50%, 75% and 100% *triticale* instead of yellow corn, respectively. The corresponding values of hen-day egg production (H.D%) were 63.46, 61.34, 64.16 and 61.54% for the same previous groups, respectively, with no significant differences among treatments. This result is similar to those reported by Castro and Costa (1992), Angelovicova and Hascik (1993) and Azman *et al.* (1997) who indicated that *triticale* as alternative ingredient to yellow corn in laying hen diets had no significant negative effect on egg production. However, Leeson and Summers (1987) found that egg production was decreased when Leghorn laying hens were fed diets containing *triticale* as a sole cereal source.

During the whole period the average egg weights were 47.28, 47.29, 47.55 and 46.96 g for eggs produced by hens fed the control diet and those fed diets containing 50, 75 and 100% *triticale* in place of yellow corn, respectively; with no significant differences. This result is in good agreement with those reported by Tima *et al*. (1989), Danczak (1990) and Azamn *et al*. (1997) who indicated that differences in egg weight were not related to inclusion rate of triticale in laying hen diets. On the other hand, Castanon *et al*. (1990) showed that egg weight increased slightly with increasing dietary *triticale* level. In contrary, Richter and Lemser (1993) observed that egg weight decreased with increasing dietary *triticale* level and addition of 1- 1.5% sunflower oil as a source of linoleic acid restored egg weight to the control level.

Because of the absence of variation among groups in egg production and egg weight, results of egg mass for the entire experimental period (30-42 weeks of age) revealed also insignificant effect of *triticale* level in the diets.

Results indicated that feeding Mandarah laying hens a diet containing 75% *triticale* instead of yellow corn as a main source of energy improved the utilization of feed by 13.20% than that of control diet (0.0 triticale); yet no significant differences were detected among treatments in feed conversion. This result is similar to those reported by Richter and Lemser (1993), Richter and Lemser (1994) and Azman *et al.* (1997) who found that triticale had no negative effect on feed conversion of laying hens. However, Castro and Costa (1992) showed that feed conversion was significantly impaired when triticale completely replaced yellow corn in layers diet.

Only 5 hens died during the whole experimental period (one hen from the control group, and 3 hens and one hen from groups fed 50 or 100% *triticale*-containing-diets, respectively). The post mortem examination indicated that hens death was not related to the dietary treatment, therefore, data were not tabulated. Similarly, Richter and Lemser (1993) reported that *triticale* had no effect on mortality rate.

Even though the performance data were in favour of group of hens fed the diet in which 75% of yellow corn was replaced by *triticale*, it could be concluded that triticale successfully replaced yellow corn at replacement rate of 50 or 75% or even 100% in local Mandarah laying hen diets; with no adverse effect on the performance for egg production and efficiency of feed utilization, or mortality rate.

2.Egg quality measurements:

Data of egg quality measurements including egg weight, egg components, yolk colour, shape index, yolk index, Haugh unit, and shell quality are shown in Table 4.

Table 4: Effect of feeding experimental diets on egg quality characteristics.

Parameters	Triticale as a percent of yellow corn in the experimental diets			
	0%	50%	75%	100%
Egg weight; g	49.95±0.52	49.88±0.45	49.61±0.48	48.62±0.50
Yolk weight; %	31.95±0.28	31.64±0.32	31.48±0.35	32.47±0.38
Albumen weight; %	58.08±0.30	58.76±0.51	58.60±0.35	57.82±0.92
Yolk colour score	4.13±0.30^{a}	2.51±0.21^{b}	2.00±0.16^{b}	1.48±0.09^{c}
Shape index	0.779±0.008	0.763±0.005	0.764±0.002	0.765±0.005
Yolk index	0.454±0.012	0.448±0.015	0.459±0.022	0.450±0.017
Haugh unit score	84.43±1.00	82.48±1.16	85.65±0.96	84.87±1.12
Shell weight; %	9.97±0.11	10.10±0.12	9.92±0.12	9.71±0.13
Shell thickness; mm	0.304±0.004	0.295±0.004	0.287±0.004	0.281±0.004
SWUSA; mg/cm^2	79±1.22^{a}	80±1.47^{a}	79±1.49^{a}	76±1.08^{b}

a-c: Means in the same row having different superscripts are significantly different (P≤0.05).

Average egg weight ranged from 48.62 to 49.95 g without significant differences among the experimental groups. This result is in agreement with those of Tima *et al*. (1989); Danczak (1990) and Azman *et al*. (1997) who found that dietary triticale did not affect egg weight in laying hens. However, Richter and Lemser (1993) showed that egg weight was decreased with increasing dietary *triticale* level, and addition of sunflower oil at a level of 1-1.5% of layers diet overcome this decrease.

The results indicated that the complete substitution of *triticale* for yellow corn in the experimental diets had no adverse effect on eggshell, yolk, or albumen percentage. Similarly, Shafey *et al.* (1992) reported that differences in yolk weight among layers fed different cereal grains were not significant.

It is apparent that increasing triticale level in the diets decreased significantly ($P<0.001$) yolk colour intensity. This is attributed to the reduction of yellow corn in the diet and subsequently to a lower xanthophyll intake. However, this result does not limit the utilization of *triticale* in laying hen diets since, xanthophyll-rich ingredients such as algae and corn gluten meal, or other synthetic source can be used to increase yolk colour. Similarly, Tima *et al*. (1989), Castanon *et al*. (1990) and Richter and Lemser (1993) indicated that intensity of yolk colour was decreased with increasing *triticale* level in laying hen diets.

Egg shape index, yolk index, and Haugh unit score of eggs produced by the experimental laying hens were not affected adversely by feeding the *triticale*-containing-diets.

Generally, shell percent, shell thickness and SWUSA parameters indicated that incorporation of *triticale* in local Mandarah laying hens diet had no deleterious effect on eggshell quality. This result is in partial agreement with that reported by Angelovicova and Hascik (1993), who found that eggshell weight percentage was not significantly related to inclusion rate of *triticale* in laying hen diets. Also, Cuca and Avila (1973) found that eggshell thickness was not affected by dietary *triticale* level.

With the exception of producing a lower yolk color score, it would be concluded that dietary *triticale* had no adverse effect on the quality of eggs produced by the experimental laying hens.

3.Reproductive performance:

Results of fertility and hatchability of fertile eggs of Mandarah laying hens as affected by dietary *triticale* level are presented in Table 5. The overall mean of fertility percentages obtained in the three studied periods were 83.51, 96.03, 95.51 and 96.22 for eggs produced by hens fed the control diet (0.0% *triticale*), and diets in which triticale replaced 50, 75 and 100% of yellow corn, respectively. Results indicated that *triticale* containing-diets significantly ($P<0.01$) improved the fertility of eggs of Mandarah laying hens. On the other hand, results obtained indicated that the hatchability (%) of fertile eggs was not affected significantly by dietary *triticale* level. The overall mean of hatchability of eggs of the experimental groups ranged from 88.40 to 90.46%; with no significant difference.

Table 5: Effect of feeding experimental diets on reproductive performance.

Parameters	Age in wks	Triticale as a percent of yellow corn in the experimental diets			
		0%	50%	75%	100%
Fertility of eggs; %	37	84.97±11.07	95.63±0.63	94.67±2.86	95.33±4.67
	39	85.13±7.32	99.03±0.97	96.83±1.88	97.93±2.07
	41	80.43±13.39	93.43±2.26	95.03±0.95	95.40±2.63
Overall mean		83.51±5.50	96.03±1.10	95.51±1.08	96.22±1.71
hatchability of fertile eggs; %	37	91.07±2.03	89.03±2.58	91.87±2.42	87.87±2.17
	39	92.27±4.48	90.37±3.21	88.43±3.00	85.30±2.75
	41	87.73±0.23	90.90±1.41	84.90±3.39	93.43±3.55
Overall mean		90.46±1.58	90.21±1.30	88.40±1.79	**88.87±1.87**
Day old chicks weight; g	37	$29.78±0.31^{b}$	$30.20±0.19^{b}$	$31.49±0.40^{a}$	$29.61±0.31^{b}$
	39	$29.89±0.29^{a}$	$29.54±0.23^{ab}$	$29.05±0.30^{b}$	$30.05±0.33^{a}$
	41	29.58±0.39	30.74±0.28	30.50±0.14	30.93±0.76
Overall mean		29.75±0.18	30.16±0.15	30.34±0.23	30.20±0.30

a, b: Means in the same row having different superscripts are significantly different (P≤0.05).

Day-old live body weight of chicks produced by hens fed different dietary *triticale* levels showed significant differences at 37 and 39 weeks of age. The results indicated that chicks of eggs from hens fed 75%-*triticale* containing-diets were significantly (P<0.05) the heaviest at 37 weeks of age and the smallest at 39 weeks. At 41 weeks of age, however, the differences in the average weight of day-old chicks among the dietary treatment groups were disappeared. Also, the overall means of day-old chick's weight showed no significant differences among treatments. It could be concluded that *triticale* successfully replaced yellow corn at the levels used in diets of the present experiment without adverse effect on reproductive traits of Mandarah laying hens. This result is in general agreement with that reported by Danczak (1990) who indicated that *triticale* containing-diets had no significant effect on fertility, hatchability or day-old chick's weight.

4.Blood constituents:

Results obtained on some blood constituents in 42-week old Mandarah laying hens fed the experimental diets are presented in Table 6.

The average values of plasma total cholesterol were 115.53, 123.33, 156.67 and 158.67 mg/100 ml in groups of hens fed diets containing *triticale* at levels of 0, 50, 75 and 100% of dietary yellow corn, respectively. Results indicating that plasma cholesterol increased significantly (P<0.01) with increasing *triticale* level in local Mandarah laying hen diets. Similar concentrations of plasma cholesterol were reported, however, by Raya *et al*. (1990) in Dokki-4 and Rhode Island Red laying hens, and Raya *et al*. (1998) in Gimmizah laying hens, irrespectively of dietary treatment or breed differences.

Table 6: Some blood constituents in 42-weeks-old Mandarah laying hens fed the experimental diets.

Items	Triticale as a percent of yellow corn in the experimental diets			
	0%	50%	75%	100%
Total cholesterol; mg/100 ml	115.53±2.2[b]	123.33±5.1[b]	156.67±13[a]	158.67±8.3[a]
Total lipids; mg/100 ml	796.03±168	847.77±174	1080.63±48	1114.43±61
Total protein; g/100 ml	6.80±0.71	8.33±0.94	7.87±0.52	8.50±0.06
Albumin; g/100 ml	4.53±0.29	3.10±0.40	3.37±0.38	3.47±0.47
Globulin; g/100 ml	2.27±0.94	5.23±1.19	4.50±0.90	5.03±0.47

a, b: Means in the same row having different superscripts are significantly different (P≤0.01).

Concentrations of plasma total lipids ranged between 796.03 mg/100 ml for group fed on free *triticale* diet and 1114.43 mg/100 ml for group fed 100% triticale of dietary corn, indicating that increasing the level of *triticale* instead of yellow corn resulted in raising plasma total lipids of laying hens, but with no significant differences. This increase in plasma total lipids may be partially due to increasing supplemental oil associated with increasing dietary *triticale* level to equalize energy content of diets, and therefore concentration of total lipids increased to some extent in the blood stream of hens. The values found herein are in general agreement with those reported by Annison (1971) and Attia (1993).

It is generally accepted that the blood of laying hens contains more total lipids compared to that of growing chicks due to higher estrogen level associated with egg laying. This coincides well with that reported by Annison (1971) who stated that the onset of lay in the hen is accompanied by marked increases in the levels of plasma lipids and phosphoproteins.

It should be pointed out, however, that the changes which were observed in the concentration of cholesterol and total lipids in plasma of experimental birds are not related to dietary *triticale* itself.

Concentrations of plasma total protein were 6.80, 8.33, 7.87 and 8.50 g/100 ml, for hens fed the control diets (0.0% triticale), and those containing *triticale* in place of yellow corn at replacement ratios of 50%, 75% and 100%, respectively, with no significant differences. The values obtained herein, are in agreement with those reported by Attia (1993) dealing with broiler breeder hens, regardless of dietary treatment or breed differences.

No significant differences were observed also in the levels of plasma globulin or albumin among experimental hen groups.

It could be concluded that substitution of *triticale* for yellow corn in the experimental diets had no adverse effect on plasma constituents of hens used in the present study.

5.Digestibility of experimental diets:

The data obtained on digestion coefficients of nutrients of the experimental diets are shown in Table 7.

Table 7: Digestibility coefficients of nutrients for the experimental diets as affected by dietary triticale level.

Items	Triticale as a percent of yellow corn in the experimental diets			
	0%	50%	75%	100%
Organic matter (OM)	81.49±0.36	81.93±0.60	81.16±0.92	81.29±1.05
Crude protein (CP)	82.43±0.42	83.72±0.61	83.18±0.59	84.59±0.52
Ether extract (EE)	68.59 ± 1.29^{B}	70.32 ± 0.98^{B}	74.23 ± 0.24^{A}	75.80 ± 0.74^{A}
Crude fiber (CF)	48.92 ± 0.84^{a}	43.81 ± 1.17^{b}	39.49 ± 0.55^{c}	38.77 ± 0.73^{c}
N-free extract (NFE)	83.620.60	84.880.95	85.61±1.21	86.92±1.62

A, B: Means in the same row having different superscripts are significantly different (P≤0.01).

a, b: Means in the same row having different superscripts are significantly different (P≤0.05).

Results indicated that the digestibility of organic matter of the experimental diets was almost constant and reached a mean value of 81.45%; with no significant differences among treatments.

The digestion coefficients of crude protein ranged from 82.43 to 84.59% with no significant difference among treatment groups. Results, however, indicated that feeding of *triticale*-containing-diets slightly improved the dietary protein digestibility as compared to control diet.

The digestion coefficients of ether extract (EE) ranged from 68.59% to 75.80% with significant differences among the experimental treatment groups. Results indicated that feeding of *triticale*-containing-diets improved ether extract digestibility. This improvement which was observed in EE digestibility was more pronounced with increasing supplemental oil level in the *triticale*-containing-diets to compensate for the energy differences between yellow corn and *triticale*, and is not attributed to dietary *triticale* itself. It is generally accepted that fat digestion and its absorption could be enhanced as EE increased from 3.13 to 7.32% in the experimental diets of the present work (Artman, 1964; and Gomez and Polin, 1974).

The digestion coefficients of crude fiber (CF) ranged from 38.77% to 48.92%, with significant differences among the experimental groups. The results indicated that increasing triticale level reduced the digestibility of CF in comparison with the control diet. This reduction may be due to the coarse nature of crude fibers of the *triticale* grains. Even though, it is well known that the digestive tract of birds does not posses specific enzymes (e,g, cellulase) for crude fiber digestion, some digestion takes place in the caecum due to microbial fermentation (Titus and Fritz, 1971).

The digestibility value of nitrogen free extract ranged from 83.62% for diet containing 0% *triticale* to 86.92% for that which contained 100% *triticale* instead of yellow corn. The differences in digestibility of nitrogen free extract of the experimental diets were statistically not significant.

Generally, it could be concluded that the digestibility of major nutrients was not adversely affected with the utilization of triticale in Mandarah laying hen diets. Although crude fiber digestibility was significantly affected, it is generally of relatively little importance as a nutrient for poultry.

6.Economic efficiency of the experimental diets:

Results presented in Table 8 showed that total feed consumption was decreased by increasing triticale level in the diet. The price/ton diet decreased when the triticale replaced yellow corn at 50%. However, it was raised with increasing the replacement ratio above 50%. Net revenue increased when triticale replaced 75% or 100% of yellow corn in the diet followed by the replacement level of 50%. The same trend was also true for economic efficiency. This improvement could be attributed to increasing egg mass and lower feed consumption. These results indicated that feeding Mandarah local laying hens on diets containing triticale as a source of untraditional energy source instead of yellow corn proved to be economical.

Table 8: Economic efficiency (E.E) of egg production of Mandarah laying hens as affected by dietary triticale level.

Items	Triticale as a percent of yellow corn in the experimental diets			
	0%	50%	75%	100%
Price of feed (L.E/ton)	708.52	688.29	740.74	712.36
Feed consumption (kg/hen)	12.173	11.640	10.708	10.953
Feed cost (L.E/hen)	8.62	8.01	7.93	7.80
Egg mass (kg/hen)	2.731	2.646	2.782	2.633
Price of kg eggs (L.E)	4.00	4.00	4.00	4.00
Total revenue (L.E/hen)	10.92	10.58	11.13	10.53
Net revenue (L.E/hen)	2.30	2.57	3.20	2.73
E.E; %	26.68	32.08	40.35	35.00

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"إستخدام حبوب التريتيكال كبديل للأذرة الصفراء في علائق الدجاج البياض"

فؤاد عبد الواحد متولي عجور، تاج الدين حسن تاج الدين، *عبد الغني إبراهيم عبد الغني، ونفين عرفة يوسف حنيش.
قسم إنتاج الدواجن – كلية الزراعة – جامعة المنصورة - * محطة بحوث الإنتاج الحيواني بسخا كفر الشيخ – وزارة الزراعة.

أجريت تجربة لدراسة القيمة الغذائية لحبوب التريتيكال باستخدام عدد 144 دجاجة بياضة من سلالة المندرة المحلية قسمت إلي 4 مجاميع. حيث تم تكوين أربع علائق تجريبية متساوية في محتواها من البروتين الخام (16% بروتين خام) والطاقة (2700 كيلوكالوري/كجم). احتوت عليقة المقارنة (الكنترول) علي الأذرة الصفراء كمصدر رئيسي للطاقة، بينما تم إضافة التريتيكال للعلائق الثلاث الأخرى ليحل محل الأذرة الصفراء بنسب إحلال 50% أو 75% أو 100%. وتم تغذية مجاميع الدجاج علي تلك العلائق التجريبية خلال الفترة ما بين عمر 30 حتى 42 أسبوع. ويمكن إيجاز النتائج فيما يلي:

1- رغم أن النتائج كانت إلي حد ما في صالح مجموعة الدجاج التي تم تغذيتها علي العليقة التي حل فيها التريتيكال محل الأذرة الصفراء بنسبة 75%، غير أنها تؤكد أنه يمكن استخدام التريتيكال ليحل كاملا محل الأذرة الصفراء في علائق دجاج المندرة المحلية بدون آثار سلبية علي المظاهر الإنتاجية للدجاج في إنتاج البيض أو معدل التحويل الغذائي، وبطريقة اقتصادية.
2- باستثناء حدوث انخفاض في درجة تلون الصفار، فإن استخدام التريتيكال في غذاء الدجاج لم يؤد إلي حدوث أي نوع من التدهور في صفات جودة البيض، وذلك بدلالة وزن البيضة ونسب مكوناتها، ووحدات هوه، ومقاييس جودة القشرة.
3- تحسنت نسبة خصوبة البيض، بينما لم تتأثر نسبة فقس البيض المخصب نتيجة استخدام التريتيكال في عليقة الدجاج.
4- لم تظهر فروق جوهرية بين مجاميع الدجاج في محتوي بلازما الدم من البروتينات الكلية، أو الدهن الكلي، أو الألبيومين، أو الجلوبيولين. ورغم ظهور فروق معنوية بين المجاميع في تركيز الكولستيرول في البلازما إلا أن ذلك غير مرتبط باستخدام التريتيكال في الغذاء.
5- لم تظهر فروق معنوية بين العلائق التجريبية في هضم مركباتها، حسبما دلت عليه معاملات هضم المادة العضوية، البروتين الخام، والدهن الخام، والمستخلص الخالي من الآزوت. ورغم وجود فرق جوهري في هضم الألياف غير أنها تعتبر قليلة الأهمية كعنصر غذائي للدواجن.