**Egypt. Poult. Sci. Vol. (40) (I): (133-151) (2020) (1912-1062)**

**Egyptian Poultry Science Journal**

**http://www.epsj.journals.ekb.eg/**

**ISSN: 1110-5623 (Print) – 2090-0570 (Online)**

# IMPROVING UTILIZATION OF BARLEY GRAINS AS A SOURCE OF ENERGY IN DUCKS DIETS UNDER SOUTH SINAI CONDITIONS

**Mona M. Hassan**

Anim. and Poul. Nutrition Dept., Desert Rese. Center, Cairo, Egypt.

**Corresponding author**: Mona M. Hassan Email:monamohamed01210@yahoo.com

Received: 19/12/2019 Accepted: 22 /01/2020

**ABSTRACT:** Four hundred and fifty Muscovy ducklings (7 days) were distributed into fifteen groups; 4 basal diets contained 0, 10, 20 or 40% of barely grains; or supplemented with 1g commercial enzyme /kg diet; or 4 pelted barely diets; finally, three sprouted percent of barley grains 10, 20 and 40% were used in three experimental diets comparing with the basal control diet. Results showed that increasing barley grains levels in duckling diets reflect significant increase in the non -starch polysaccharides (NSP) and duodenum viscosity ;gradual decrease in digestibility coefficient and nutritive values; ducklings fed diet contained 40% barley grain had lower significant gain compared with control; gradual decrease in feed intake with increase in feed conversion; decrease in carcass % . Adding enzyme or pelleting the experimental diets improved digestibility coefficients and nutritive values. Sprouting technique had recorded the highest desirable results which reflect that group fed 40% barley grains had the best feed conversion compared with other treatments and lowest weights was recorded by group fed basal diet; the highest relative economic efficiency were for groups fed sprouted barley 20% or 40% being 105%.

**Keywords:** Barley – enzyme - pelting –sprouting – Ducks.

## INTRODUCTION

Production of the ethanol of maize is currently increasing and predicted for the future increase as a result of rising cost fossilized oil and environmental pollution issues (IFAD, 2008). Increasing demand for liquid fuel produced internally increases competition between animal feed and fuel uses of maize production. As a result, the last rise in the requirement and increase in affiliate is the cost yellow corn. They are interested in substituting it for the poultry diet with other locally grown energy grains (Mehri *et al.*, 2009). Barley (*Hordeum vulgare*) as an energy source can use in poultry feeds, but barley's carbohydrates cannot be digested easily because antinutritional factor identified as ß-glucan, which increased the viscosity of the intestinal contents by binding with intestine water formatted a gels that reduced digestion (Smits and Annison, 1996) and reduced the availability of the diet nutrients (Moghaddam *et al.*, 2009). Some enzymes can break down the beta-glucans, reduced viscosity, increased availability of nutrient, and improved performance (Khidr *et al.*, 2005). Better poultry gains were obtained by pelleted feeds than a mash diet; by breaking down the starches; minimizes waste of feeding; increased digestible feeds with a simply feed form (Mona and El-Sheikh, 2010). The trend of using sprouted grains in poultry diet is increasing due to many reasons, improvement their nutritive value (Amal *et al.*, 2007); due to the conversion of complex compounds into simpler ,reducing antinutritional factors effects, increased protein quality ,increased sugars, certain minerals and vitamin contents which reflect in increased the plant enzyme contents (Shipard, 2005). Although there is insufficient information on the use of barley in poultry. Accordingly, this study was designed to investigate how we can improve utilization of barley grains as a source of energy for ducklings by adding commercial enzymes, pelting process or sprouting technique.

## MATERIALS AND METHODS

This experiment was conducted experimental research station (Ras Suder city- south Sinai), Desert Research Center, Egypt. Four hundred and fifty of 7 days old Muscovy ducklings of genotype ST14 (fed on starter diet contained 2800 ME Kcal/kg. and 22%CP from hatching up to 35 days old and finisher diet contained 2900 ME Kcal/kg. and 18%CP from36 days up to 70 days old), were distributed in fifteen experimental groups, each group was allocated into three replicates (10 birds each).

**Composition of diets**: Fifteen experimental diets were formulated (Tables 1 and 2) as Muscovy ducks guide recommended being iso-caloric and iso-nitrogenous; the first 4 diets contained 0,10,20 or 40% of barely grains; the second 4 diets contained the same barley groups supplemented with 1g/kg from commercial enzyme (Ensdo-1,3(4) beta-glucanase 40,000 u/kg, Protease 10,000 mg/kg,Pectinase 40,000 mg/kg, Amylase 8,000,000 mg/kg, Caclcium carbonate 16 mg/kg up to 1kg); the third 4 diets were pelted diets with 0,10,20 or 40% of barely grains ; finally, three sprouted barley grains percent 10,20 and 40% were used in three experimental diets comparing with the basal control diet.

**Sprouted technique:** Grains sprouts as described by Mohammadi *et al.*, (2007) using local barley grains (*Hordeum vulgare* L.) that cleaned and soaking for 30 minutes in a 2% sodium hypochlorite solution to prevent mold formation; soaked grains (about 12 hours) were spread evenly on the growing cabinet; germination period were lasted about 7 days to get shoot sprouts. Planting trays were irrigated with tap water once a day early in the morning to provide enough water to keep the seeds/ seedlings moist.

**Digestibility trail:** 45 males of ducks (three / treatment) were used to determine the digestion coefficients of the experimental diets at the end of expremint.

**Carcass traits:** Three birds from each treatment were selected randomly and held without feed 12 hours, without water about 4 hours, weighed and slaughtered to complete bleeding and then weighed, carcass parts were weighed and calculated as a percentage of live body weight.

**Duodenum viscosity:** The method of Dusel et al.,(1997) was used to determine raw material viscosity of intestinal content ; sampled from duodenum level was centrifuged at 10,000 revolutions/ minute for 10 minutes, extracted and determined with the Brookfield viscometer.

**Economic efficiency:** From the input-output analysis the economic efficiency was calculated as follows: feed cost/kg gain=feed conversion x cost of one kg diet. , Net return= price of one Kg meat (LE.)- cost of Kg feed (LE) and Economical efficiency %= Net return/ price of one kg meat (LE.)

**Statistical analysis:** According to SAS (2002) and Duncan's New Multiple Range test (Duncan, 1955) were used in one -way classification .The statistical model was: $Y_{ijk} = U + T_i + e_{ik}$., Where: $Y_{ik}$ = Observation, U = the overall mean , $T_i$ = experimental treatments (i=1, 2, 3and 4), $e_{ik}$ = Random error.

## RESULTS

**Chemical composition of tested grains:**

Table 3 showed that the chemical composition of yellow corn were 8.80% CP, 1.92 CF, 4.32 EE, 1.47 ash, 83.49 NFE and 3350 kcal.ME./kg .It was clear that; dried barley grains contained higher CP,CF and ash% (11.15, 6.56 and 3.91%;respectively) but lower ME being 2640 kcal/kg compared with the yellow corn grains. However, sprouting barley grains had increased the CP, CF, ash and ME contents being 14.84, 18.00, 11.44 and 3320 kcal.ME./kg; respectively compared with dried barley grains. These values are nearly similar to those reported by Jadhav and Siddiqui (2010) who demonstrated that barley is lower in energy, higher in fiber and less palatable compared to maize. In this connection, Dastar *et al*. (2014) showed that chemical composition of barley grains were 10.30%CP, 1.90%EE, 5.00%CF and 2.50% ash; the variation of the chemical composition of barley grains may be due to the differences between cultivars, climatic and soil conditions in different geographical locations. Increasing CP in sprouted barley grains from 14.32 (at day 6) to 20.04% (at day 8) were recorded by Helal (2015). The opinion of AL-Saadi and Ibrahim (2016) may explain the increases in nutrients which reflect the loss of DM mainly in the form of carbohydrates due to respiration during sprouting of barley grains.

**Non starch polysaccharides (NSP) contents of tested grains:**

Data in Table 4 refer to the NSP contents of tested grains; yellow corn contains total NSP being 8.10 (0.81 soluble and 7.29 insoluble); however, barley grains contains 16.70 total NSP (4.50 soluble and 12.20 insoluble). It was clear that sprouted barley grains had beneficial effects in reducing total NSP being 13.72 (3.72 soluble and 10.00 insoluble) especially β-glucans which lowered from 4.30 to 3.54% and Arabinoxylan lowered from 7.80 to 6.41%. Gandon (1995) reported that variability of barley β-glucans was clearly not related to the type of barley, but more to the spring vs. winter cultivars. Ştef *et al.* (2011) reported that barley grains contain 4.3 %of β-glucans. On the other hand; Allosio-Ouarnier *et al.*(2000) found a breakdown of barley β-glucans (5 to 1%) resulted from β-glucanaseis produced during grain germination .

**NSP contents of tested treatments and duodenum viscosity:**

Table 5 showed that there were significant increases in total non-starch polysaccharides ($NSP_{t}$), soluble non-starch polysaccharides ($NSP_{s}$) and insoluble non-starch polysaccharides ($NSP_{i}$)% with increasing barley grains levels in the diet which reflect significant increase in the duodenum viscosity and viscosity percentage; however, adding enzyme to the experimental diets was reduced $NSP_{i}$ % with increasing $NSP_{s}$% resulting in reducing duodenum viscosity and viscosity percentage in comparing with the untreated groups. Similar trends were obtained with the pelleting groups but there were more reduction in duodenum viscosity and viscosity percentage in comparing with the groups of enzyme addition. It was clear that sprouting technique had recorded the highest desirable results which reflect the improvement in barley grains content of NSP and finally reduced values of duodenum viscosity of 40% of barley grains to be equal with corn control diet with insignificant differences in viscosity percentage between control and sprouted groups. The vital effective on poultry performance and out put of its industry production were the nutritive value of barley which could be influenced by NSPs quantity and quality; there were many searchers who explained these results with different opinions; Almirall *et al.* (1995) showed that feeding barley-based diets broiler chicks had increased intestinal viscosity, decreased digestive enzyme activities; and when added β-glucanase the intestinal viscosity reduced and slowed the growth of *Escherichia coli* resulted in improving nutrient utilization of broilers Juanpere *et al.* (2005). On the other side; Ankrah *et al.* (1999) showed that pelleting had reduced digesta viscosity by 45%compared with un- pelted barley diet; similar trends were obtained when Peer and Leeson (1985) sprouted the barley grains.

**Digestibility coefficient and nutritive value:**

Table 6 showed that increasing barley grain levels in the experimental diets reflected a gradual decrease in digestibility coefficients and nutritive values. On the other hand; adding enzyme to experimental diets cause an improvement in digestibility coefficients and nutritive values; more improving were obtained by pelting process .It was clear that; sprouting technique for barley grains recorded the highest improvement in digestibility coefficients and nutritive values to the extent that there were insignificant differences among basal group and ducklings fed 40% sprouted barley in digestibility of DM, CP and CF, moreover; sprouted groups recorded the highest EE digestibility compared with control group. The reasons of lower lipid digestibility in broilers fed diets with higher NSPs content may be the overgrowth of bacterial in the small intestine or subsequent excessive deconjugation of bile acids, which reduces their effect in solubilizing lipids (Salih *et al.*, 1991). Smits *et al.* (1997) explained that the viscosity reduced the mixing of intestinal contents or and alters the transport properties of the nutrients at the mucosal surface. Releasing of bile and pancreatic enzymes occurs in the duodenum which improved digestibility, absorption of nutrients and performance (Rodriguez *et al.*, 2012). On the other side, Yasar and Forbes (1999) reported that sprouted barley hydroponically for 7 days improved digestibility of DM and fat, and decreased viscosity. Increasing development of the layer of villi in the digestive segments and reducing crypt cell proliferation rate of the intestinal epithelium were obtained when poultry fed wet feeds which reflect decreasing intestinal viscosity.

**Live body weight and body weight gain**

Table 7 showed that increasing barley grain levels in the experimental diets up to 20% had insignificant effect on weights parameters, however; feeding ducklings diet contained 40% barley grain had lower significant gain compared with control. When adding enzymes there were a significant superior in body weight and gain in ducklings' diets contained 10 and 20% barley grains, while; both control and group contained 40% barley grains recorded similar insignificant weights. Pelting barley grains diets (10, 20 and 40%) recorded highest significant live body weight and body gain compared with pelted control diet. It was clear that; sprouting technique for barley grains recorded the highest improvement in live body weight and body gain values to the extent that ducklings fed 40% sprouted barley had the heavier weights compared with other treatments and lowest weights was recorded by group fed basal diet. The increase in gastrointestinal viscosity can cause reductions in growth rate and nutrient absorption (El- Nahas *et al.*, 2011); however; mixture enzymes that contains phytase and NSP improved body weight and feed conversion of ducks (Hong *et al*. 2002) and broilers (Thacker ,2013). On the other hand, Pettersson and Aman(1991) showed that pelleted feeds contained barley increased growth rate , FE and digestibility's of birds. The benefits of sprouting was discuss by Shewry *et al*., (1995) who reported that germination activated protease enzymes and convert the protein polymers into amino acids ;activated amylase and lipase which increased the sugar and essential fatty acid content of grains. The same trend was investigated by Osman *et al.* (2018) who found that replacing sprouted or germinated barley instead of yellow corn (w/w) from 25%up to 75% in broiler chick diets significantly increased body weight and body weight gain during the growing period(at 6 wks. old).

**Feed intake and conversion**

Table 8 showed that increasing barley grain levels in the experimental diets reflected a gradual decrease in feed intake with increase in feed conversion. On the other hand; adding enzyme to experimental diets cause an improvement in feed conversion ; more improving were obtained by pelting process .It was clear that; sprouting technique for barley grains recorded increases in feed intake with improvement in feed conversion to the extent that group fed 40% barley grains had the best feed conversion. As intestinal viscosity increased ;the feed conversion decreased ( Bedford,2000) and when Beta-glucanase added improved body weight gain,conversion and starch digestibility (Boguhn and

Rodehutscord ,2010). However ; Sundu *et al*. (2005) found that pelleting had not affect gain, feed intake and FCR, but reduced viscosity and increased starch digestibility when diet non- supplemented with enzyme. Regarding sprouted barely, Osman *et al.* (2018) reported that substituting yellow corn with sprouted or germinated barley in broiler chick diets significantly increased feed consumption during starting, growing and whole experimental periods and this effect was progressively increased with increasing the level of replacement from 25% up to 75%. Also, broiler chicks fed on the diets contained sprouted or germinated barley instead of yellow corn from 25% up to 75% were recorded significantly better feed conversion ratios compared to those fed on the control diet at growing and entire experimental periods .

**Carcass traits**

Table 9 showed that increasing barley grain levels in the experimental diets reflected a gradual decrease in carcass % and gradual increase in digestive tract weight (%), digestive tract length (cm) and cecum length (cm). On the other hand; adding enzyme to experimental diets cause an improvement in carcass % and there were no effects on other carcass traits ; more significant reduction in carcass %and giblets % were obtained by pelting diets .It was clear that; sprouting technique for barley grains recorded increases in carcass % at the same time for all barley levels with significant gradual decrease in abdominal fat , digestive tract weight (%),digestive tract length (cm) and cecum length (cm) . Maisonner *et al.*, (2001) concluded that NSP in barley reduced abdominal fat to 2.5% of carcass weight , reducing intestinal size and weight and so decreased digestibility rate. Svihus *et al*., (1997) fed chickens on barley diets supplemented with enzyme ortreated or germinated had lower viscosity than control. Increasing feed intake of poultry fed pelleted diet; recorded bigger gizzard size and heavier intestinal weight (Sundu *et al*., 2005). There were appositive correlation between digesta quantity in both gizzard and intestine with the flow of digesta in the broilers digestive tract which affect feed digestibility (Sundu *et al*., 2008).

**Economical evaluation**

Table 10 showed that the lowest feed cost was recorded by sprouted treatments; the highest economic efficiency (EE) and relative economic efficiency (REE) were for group fed pelted diets contained 20% barley grains (104%), groups fed sprouted barley 20% or 40% being 105%. Poultry are good feed converters and grow rapidly; so that, the best logical solution to animal protein problem is increasing poultry production; so that, substituted maize with any source of energy poultry feeds will positively reduce the cost of poultry production (Bamgbose *et al.*, 2004). Mona *et al.* (2015) reported that the highest value for EE and REE were 0.77 and 124% which obtained when duckling diet supplemented with enzyme. Mona and El-Sheikh (2010) found that feeding ducklings' pelted diet recorded the highest net return and economic efficiency. However, Osman *et al*. (2018) revealed that replacing yellow corn with sprouted or germinated barley in broiler chick diets from 25% up to 75% (w/w) significantly increased the absolute and the relative return/bird. Previous studies showed that profitable application with high value outputs from hydroponic system were recorded in intensive and small-scale livestock situations (Naik *et al.*, 2015).

## CONCLOSION

It may be concluded that sprouting technique is the best method for improving utilization of barley grains without any deleterious effects on ducks performance.

**Table (1):** Composition and proximate chemical analysis of the starter experimental diets.

| Ingredients (%) | Starter diets (7-35days) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Control | barley grains | | | Sprouted barley grains | | |
| | 0% | 10% | 20% | 40% | 10% | 20% | 40% |
| Barley grains | 0.00 | 10.00 | 20.00 | 40.00 | 0.00 | 0.00 | 0.00 |
| Sprouted barley grains | 0.00 | 0.00 | 0.00 | 0.00 | 10.00 | 20.00 | 40.00 |
| Yellow corn | 56.15 | 46.00 | 33.05 | 7.65 | 47.65 | 38.00 | 20.70 |
| Soybean meal (44%CP) | 31.50 | 33.00 | 34.10 | 32.50 | 31.00 | 29.00 | 31.00 |
| Corn gluten meal (60%CP) | 4.60 | 5.50 | 6.50 | 11.50 | 3.50 | 3.50 | 0.00 |
| Wheat bran | 3.50 | 0.55 | 0.00 | 0.00 | 4.25 | 5.50 | 3.90 |
| Vegetable oil | 0.00 | 0.70 | 2.10 | 4.20 | 0.00 | 0.20 | 0.50 |
| Limestone | 1.45 | 1.45 | 1.45 | 1.45 | 1.00 | 1.00 | 1.00 |
| Dicalcium phosphate | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| NaCl | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Vit& Min premix* | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| DL- Methionine | 0.15 | 0.10 | 0.10 | 0.00 | 0.00 | 0.15 | 0.25 |
| L-Lysine-HCl | 0.10 | 0.10 | 0.10 | 0.10 | 0.00 | 0.05 | 0.05 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| **Calculated analysis**** | | | | | | | |
| ME, K cal/kg | 2860 | 2808 | 2804 | 2800 | 2800 | 2801 | 2800 |
| Crude protein (%) | 22 | 22 | 22 | 22 | 22 | 22 | 22 |
| Crude fiber (%) | 3.86 | 4.05 | 4.51 | 5.22 | 4.57 | 5.75 | 6.92 |
| Calcium (%) | 1.10 | 1.10 | 1.10 | 1.10 | 1.00 | 1.00 | 1.02 |
| Av. Phosphorus (%) | 0.51 | 0.50 | 0.51 | 0.52 | 0.50 | 0.50 | 0.50 |
| Lysine (%) | 1.15 | 1.20 | 1.24 | 1.27 | 1.10 | 1.10 | 1.13 |
| Methionine% | 0.52 | 0.57 | 0.59 | 0.64 | 0.50 | 0.50 | 0.55 |
| Methionine & Cystine | 0.88 | 0.93 | 0.93 | 0.99 | 0.86 | 0.83 | 0.85 |
| Price /Ton (LE) | 5405 | 5517 | 5922 | 6683 | 5057 | 5184 | 5157 |
| **Determined analysis%** | | | | | | | |
| CP | 22.00 | 22.00 | 22.00 | 22.00 | 22.00 | 22.00 | 22.00 |
| CF | 3.73 | 3.98 | 4.42 | 5.20 | 5.40 | 7.01 | 10.20 |
| EE | 2.90 | 2.62 | 4.38 | 5.90 | 2.76 | 2.80 | 2.72 |
| Ash | 6.10 | 6.30 | 6.70 | 6.84 | 6.85 | 7.80 | 9.10 |
| NFE | 65.27 | 65.10 | 62.50 | 60.06 | 62.99 | 60.39 | 55.98 |

** Each3 kg Vitamins and minerals contain :Vit. A120000IU,Vit. $D_3$ 22000 IU, Vit.E100 mg,Vit.$K_3$ 20mg, Vit. $B_1$ 10 mg, Vit. $B_2$ 50mg,Vit. $B_6$ 15 mg, Vit.$B_{12}$ 100 µg, Pantothenic acide 100mg,Niacin 300mg,Folicacid10mg,Biotin500µg, iron300mg,Manganese 600 mg, Choline chloride 500 mg, Iodine 10 mg, Copper 100 mg, Seleneium 1 mg, Zinc 500 mg and 1200 mg Anti-oxidant . Non-sprouted (control) =four barley levels(0,10,20 and 40 %) – Enzyme addition was on samilar four barley levels

**Table (2):** Composition and proximate chemical analysis of the finisher experimental diets.

| Ingredients (%) | Finisher diets (36-70days) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Control | barley grains | | | Sprouted barley grains | | |
| | 0% | 10% | 20% | 40% | 10% | 20% | 40% |
| Barley grains | 0.00 | 10.00 | 20.00 | 40.00 | 0.00 | 0.00 | 0.00 |
| Sprouted barley grains | 0.00 | 0.00 | 0.00 | 0.00 | 10.00 | 20.00 | 40.00 |
| Yellow corn | 61.80 | 55.30 | 48.30 | 30.10 | 53.60 | 45.30 | 27.60 |
| Soybean meal (44%CP) | 20.00 | 20.00 | 20.00 | 19.00 | 20.00 | 21.50 | 20.00 |
| Corn gluten meal (60%CP) | 4.50 | 4.50 | 3.80 | 3.50 | 3.50 | 1.30 | 0.00 |
| Wheat bran | 7.80 | 4.30 | 2.00 | 0.00 | 7.00 | 6.00 | 6.45 |
| Vegetable oil | 1.50 | 1.50 | 1.50 | 3.00 | 1.50 | 1.50 | 1.50 |
| Limestone | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.00 |
| Dicalcium phosphate | 2.05 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.50 |
| NaCl | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Vit& Min premix* | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| DL- Methionine | 0.15 | 0.20 | 0.20 | 0.22 | 0.20 | 0.25 | 0.30 |
| L-Lysine-HCl | 0.10 | 0.10 | 0.10 | 0.08 | 0.10 | 0.05 | 0.05 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| **Calculated analysis**** | | | | | | | |
| ME, K cal/kg | 2920 | 2908 | 2903 | 2900 | 2900 | 2900 | 2900 |
| Crude protein (%) | 18.03 | 18.00 | 18.00 | 18.00 | 18 | 18 | 18 |
| Crude fiber (%) | 3.06 | 3.21 | 3.62 | 4.46 | 4.57 | 6.11 | 7.91 |
| Calcium (%) | 1.10 | 1.10 | 1.10 | 1.10 | 1.11 | 1.14 | 1.11 |
| Av. Phosphorus (%) | 0.51 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Lysine (%) | 0.88 | 0.88 | 0.89 | 0.88 | 0.89 | 0.87 | 0.87 |
| Methionine% | 0.47 | 0.52 | 0.51 | 0.52 | 0.50 | 0.53 | 0.55 |
| Methionine & Cystine | 0.78 | 0.83 | 0.82 | 0.82 | 0.80 | 0.80 | 0.80 |
| Price /Ton (LE) | 5087 | 5175 | 5209 | 5537 | 5083 | 5006 | 5025 |
| **Determined analysis%** | | | | | | | |
| CP | 18.00 | 18.00 | 18.00 | 18.00 | 18.00 | 18.00 | 18.00 |
| CF | 3.50 | 3.65 | 3.91 | 4.58 | 5.04 | 6.65 | 9.84 |
| EE | 4.68 | 4.50 | 4.31 | 5.36 | 4.51 | 4.32 | 4.00 |
| Ash | 5.30 | 5.59 | 6.10 | 6.10 | 6.03 | 7.05 | 9.08 |
| NFE | 68.52 | 68.26 | 67.68 | 65.96 | 66.42 | 63.98 | 59.08 |

** Each3 kg Vitamins and minerals contain :Vit. A120000IU,Vit. $D_3$ 22000 IU, Vit.E100 mg,Vit.$K_3$ 20mg, Vit. $B_1$ 10 mg, Vit. $B_2$ 50mg,Vit. $B_6$ 15 mg, Vit.$B_{12}$ 100 µg, Pantothenic acide 100mg,Niacin 300mg,Folicacid10mg,Biotin500µg, iron300mg,Manganese 600 mg, Choline chloride 500 mg, Iodine 10 mg, Copper 100 mg, Seleneium 1 mg, Zinc 500 mg and 1200 mg Anti-oxidant . Non-sprouted (control) =four barley levels (0,10,20 and 40 %) – Enzyme addition was on similar four barley levels

**Table (3):** Chemical composition of yellow corn, dried barley grains and sprouted Barley grains (DM basis)

| Ingredient | DM % | OM % | CP % | CF % | EE % | Ash % | NFE % | ME kcal/kg |
|---|---|---|---|---|---|---|---|---|
| Yellow corn | 95.00 | 98.53 | 8.80 | 1.92 | 4.32 | 1.47 | 83.49 | 3350 |
| Barley grains | 92.25 | 96.08 | 11.15 | 6.56 | 2.06 | 3.91 | 76.32 | 2640 |
| Sprouted grains | 92.83 | 88.56 | 14.84 | 18.00 | 2.39 | 11.44 | 53.33 | 3320 |

**Table (4):** Corn, barley grains and sprouted barley grains contents of NSP

| Ingredient | Soluble NSP | Insoluble NSP | Total NSP | Total NSP contents | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Arabino-xylan | β-glucan | Cellulose | Mannan | Pectin |
| Yellow corn | 0.81 | 7.29 | 8.10 | 5.20 | 0.10 | 2.00 | 0.20 | 0.60 |
| Barley grains | 4.50 | 12.20 | 16.70 | 7.80 | 4.30 | 3.90 | 0.20 | 0.50 |
| Sprouted grains | 3.72 | 10.00 | 13.72 | 6.41 | 3.54 | 3.20 | 0.16 | 0.41 |

**Table (5):** Effect of barley grains level, enzyme addition, processing technique and sprouting barley grains on NSP contents and duodenum viscosity of ducklings.

| Treatments | NSPs1 (%) | NSPi2 (%) | NSPt3 (%) | *Viscosity cP Duodenum | Viscosity Percentage evolution |
|---|---|---|---|---|---|
| **Barley%** | | | | | |
| 0% | 0.89 [d] | 9.30 [b] | 10.19 [d] | 3.80 [c] | 1.00 [c] |
| 10% | 1.25 [c] | 9.59 [ab] | 10.84 [c] | 4.90 [b] | 1.29 [b] |
| 20% | 1.61 [b] | 9.88 [a] | 11.49 [b] | 5.20 [b] | 1.37 [b] |
| 40% | 1.97 [a] | 10.20 [a] | 12.17 [a] | 5.80 [a] | 1.53 [a] |
| ±SE | 0.60 | 0.65 | 1.00 | 0.30 | 0.10 |
| **Enzyme addition (1g/kg diet)** | | | | | |
| 0% | 1.24 [c] | 8.95 [c] | 10.19 [d] | 3.40 [c] | 1.00 [c] |
| 10% | 1.88 [b] | 8.96 [c] | 10.84 [c] | 4.51 [b] | 1.33 [b] |
| 20% | 1.90 [b] | 9.59 [b] | 11.49 [b] | 4.78 [b] | 1.41 [b] |
| 40% | 2.03 [a] | 10.14 [a] | 12.17 [a] | 5.34 [a] | 1.57 [a] |
| ±SE | 0.30 | 0.60 | 1.00 | 0.20 | 0.11 |
| **Processing technique (pellets)** | | | | | |
| 0% | 1.43 [c] | 8.76 [c] | 10.19 [d] | 3.14 [c] | 1.00 [d] |
| 10% | 2.16 [b] | 8.68 [c] | 10. 84 [c] | 3.50 [b] | 1.11 [c] |
| 20% | 2.36 [a] | 9.13 [b] | 11.49 [b] | 3.80 [b] | 1.21 [b] |
| 40% | 2.42 [a] | 9.75 [a] | 12.17 [a] | 4.20 [a] | 1.34 [a] |
| ±SE | 0.40 | 0.20 | 1.00 | 0.30 | 0.10 |
| **Sprouting barley grains** | | | | | |
| 0% | 0.89 [c] | 9.30 [a] | 10.19 [d] | 3.80 [a] | 1.00 |
| 10% | 2.34 [b] | 8.50 [c] | 10.84 [c] | 3.42 [b] | 0.90 |
| 20% | 2.55 [a] | 8.94 [b] | 11.49 [b] | 3.66 [b] | 0.96 |
| 40% | 2.58 [a] | 9.59 [a] | 12.17 [a] | 3.95 [a] | 1.04 |
| ±SE | 0.60 | 0.35 | 1.00 | 0.20 | 0.10 |

1 soluble non-starch polysaccharides
2 insoluble non-starch polysaccharides
3 total non-starch polysaccharides
*cP: centipoises; 2U/mg CP: Units of enzymes per one milligram of pancreatic crude protein.
a, b ....Means in the same column in each classification bearing different letters differ significantly ($P \leq 0.05$).

**Table (6):** Effect of barley grains level, enzyme addition, processing technique and sprouting barley grains on digestion coefficients% of ducklings.

| Treatments | digestion coefficients% | | | | | | |
|---|---|---|---|---|---|---|---|
| | DM | CP | CF | EE | NFE | TDN | DCP |
| | | | | | | | **Barley%** |
| 0% | 70.04 [a] | 74.27 [a] | 36.40 [a] | 65.75 [a] | 75.24 [a] | 60.33 [a] | 11.20 [a] |
| 10% | 69.75 [a] | 74.00 [a] | 36.09 [a] | 65.12 [a] | 74.10 [a] | 60.10 [a] | 11.14 [a] |
| 20% | 67.80 [b] | 70.04 [b] | 32.37 [b] | 63.80 [b] | 72.35 [b] | 59.00 [b] | 10.47 [b] |
| 40% | 65.00 [c] | 68.17 [c] | 29.50 [c] | 60.00 [c] | 69.03 [c] | 56.27 [c] | 9.65 [c] |
| ±SE | 1.00 | 1.14 | 0.19 | 2.10 | 2.00 | 0.58 | 2.31 |
| **Enzyme addition (1g/kg diet)** | | | | | | | |
| 0% | 70.22 [a] | 75.42 [a] | 38.00 [a] | 69.00 [a] | 76.02 [a] | 62.10 [a] | 11.80 [a] |
| 10% | 70.40 [a] | 76.00 [a] | 38.26 [a] | 68.52 [a] | 75.13 [a] | 61.92 [a] | 12.10 [a] |
| 20% | 69.50 [a] | 74.20 [b] | 35.00 [b] | 65.45 [b] | 75.00 [a] | 61.50 [ab] | 11.15 [b] |
| 40% | 67.00 [b] | 71.82 [c] | 31.90 [c] | 62.27 [c] | 70.22 [b] | 60.00 [b] | 10.30 [c] |
| ±SE | 0.15 | 0.90 | 1.14 | 1.14 | 1.14 | 1.14 | 1.14 |
| **Processing technique (pellets)** | | | | | | | |
| 0% | 70.26 [a] | 75.62 [b] | 39.04 [a] | 72.17 [a] | 75.50 [a] | 62.90 [a] | 12.10 [a] |
| 10% | 70.42 [a] | 76.70 [a] | 38.60 [a] | 71.90 [a] | 75.00 [a] | 62.50 [a] | 12.80 [a] |
| 20% | 70.00 [a] | 76.50 [a] | 36.10 [b] | 69.00 [b] | 74.82 [a] | 62.60 [a] | 12.50 [a] |
| 40% | 68.11 [b] | 72.05 [c] | 31.70 [c] | 65.37 [c] | 74.00 [b] | 61.00 [b] | 11.00 [b] |
| ±SE | 0.12 | 0.10 | 0.15 | 1.00 | 0.10 | 0.12 | 0.10 |
| **Sprouting barley grains** | | | | | | | |
| 0% | 70.04 [b] | 74.27 [b] | 36.40 [b] | 65.75 [c] | 75.24 [b] | 60.33 [b] | 11.20 [c] |
| 10% | 71.06 [a] | 80.10 [a] | 38.90 [a] | 73. 80 [a] | 78.10 [a] | 63.80 [a] | 14.33 [a] |
| 20% | 71.20 [a] | 80.00 [a] | 38.65 [a] | 73. 00[a] | 77.42 [a] | 63.50 [a] | 14.10 [a] |
| 40% | 70.00 [b] | 75.70 [b] | 35.60 [b] | 70.45 [b] | 76.00 [b] | 62.60 [a] | 13.20 [b] |
| ±SE | 0.11 | 0.18 | 0.10 | 0.16 | 0.22 | 0.58 | 0.10 |

a, b ....Means in the same column in each classification bearing different letters differ significantly ($P \leq 0.05$).

**Table(7):** Effect of barley grains level, enzyme addition, processing technique and sprouting barley grains on live body weight and weight gain of ducklings.

| Treatments | Live body weight | | | Weight gain | | |
|---|---|---|---|---|---|---|
| | **7days** | **35days** | **70days** | **7-35 days** | **35-70 days** | **7-70 days** |
| **Barley%** | | | | | | |
| 0% | 69 | 1184 | 3514 $^{a}$ | 1115 $^{a}$ | 2330 $^{a}$ | 3445 $^{a}$ |
| 10% | 69 | 1195 | 3407 $^{ab}$ | 1126 $^{a}$ | 2212 $^{ab}$ | 3338 $^{ab}$ |
| 20% | 71 | 1215 | 3360 $^{ab}$ | 1144 $^{a}$ | 2145 $^{ab}$ | 3289 $^{ab}$ |
| 40% | 72 | 914 | 2734 $^{b}$ | 842 $^{b}$ | 1820 $^{b}$ | 2673 $^{b}$ |
| ±SE | 0.27 | 1.27 | 52.87 | 30.12 | 51.22 | 75.24 |
| **Enzyme addition (1g/kg diet)** | | | | | | |
| 0% | 69 | 1290 $^{b}$ | 3590 $^{b}$ | 1221 $^{a}$ | 2300 $^{b}$ | 3521 $^{b}$ |
| 10% | 70 | 1339 $^{a}$ | 3753 $^{a}$ | 1269 $^{a}$ | 2414 $^{a}$ | 3683 $^{a}$ |
| 20% | 70 | 1357 $^{a}$ | 3790 $^{a}$ | 1287 $^{a}$ | 2433 $^{a}$ | 3720 $^{a}$ |
| 40% | 71 | 1300 $^{b}$ | 3476 $^{b}$ | 1229 $^{b}$ | 2176 $^{b}$ | 3405 $^{c}$ |
| ±SE | 0.12 | 30.68 | 66.70 | 29.75 | 43.82 | 65.45 |
| **Processing technique (pellets)** | | | | | | |
| 0% | 69 | 1236 | 3638 $^{b}$ | 1167 | 2402 | 3569 $^{b}$ |
| 10% | 67 | 1376 | 3788 $^{a}$ | 1309 | 2412 | 3721 $^{a}$ |
| 20% | 69 | 1435 | 3852 $^{a}$ | 1366 | 2417 | 3783 $^{a}$ |
| 40% | 70 | 1416 | 3782 $^{a}$ | 1346 | 2366 | 3712 $^{a}$ |
| ±SE | 0.30 | 33.05 | 25.61 | 33.11 | 37.70 | 25.49 |
| **Sprouting barley grains** | | | | | | |
| 0% | 69 | 1184 $^{b}$ | 3514 $^{b}$ | 1115 $^{b}$ | 2330 | 3445 $^{b}$ |
| 10% | 70 | 1425 $^{a}$ | 3950 $^{a}$ | 1355 $^{a}$ | 2525 | 3880 $^{a}$ |
| 20% | 71 | 1536 $^{a}$ | 4040 $^{a}$ | 1465 $^{a}$ | 2504 | 3969 $^{a}$ |
| 40% | 69 | 1549 $^{a}$ | 4058 $^{a}$ | 1479 $^{a}$ | 2509 | 3989 $^{a}$ |
| ±SE | 0.10 | 36.77 | 41.33 | 36.69 | 32.80 | 41.17 |

a, b ....Means in the same column in each classification bearing different letters differ significantly ($P \leq 0.05$).

**Table(8):** Effect of barley grains level, enzyme addition, processing technique and sprouting barley grains on feed intakes and feed conversion of ducklings.

| Treatments | Feed intakes | | | Feed conversion | | |
|---|---|---|---|---|---|---|
| | 7-35 days | 35-70 days | 7-70 days | 7-35 days | 35-70 days | 7-70 days |
| **Barley%** | | | | | | |
| 0% | 3040 [d] | 5453 [d] | 8493 [d] | 2.73 [b] | 2.34 [c] | 2.47 [b] |
| 10% | 3236 [a] | 5676 [a] | 8757 [b] | 2.87 [b] | 2.57 [b] | 2.62 [b] |
| 20% | 3160 [b] | 5596 [b] | 8913 [a] | 2.76 [b] | 2.61 [b] | 2.71 [b] |
| 40% | 3103 [c] | 5567 [c] | 8670 [c] | 3.69 [a] | 3.06 [a] | 3.24 [a] |
| ±SE | 21.82 | 24.23 | 45.76 | 0.02 | 0.05 | 0.07 |
| **Enzyme addition (1g/kg diet)** | | | | | | |
| 0% | 3060 [a] | 5497 [a] | 8557 [a] | 2.51 [a] | 2.39 [b] | 2.43 [a] |
| 10% | 2776 [c] | 5306 [d] | 8083[d] | 2.19 [c] | 2.20 [c] | 2.19 [b] |
| 20% | 2943 [b] | 5395 [c] | 8340[c] | 2.29 [b] | 2.22 [c] | 2.24 [b] |
| 40% | 3056 [a] | 5426 [b] | 8483[b] | 2.49[a] | 2.49 [a] | 2.49 [a] |
| ±SE | 34.90 | 20.61 | 54.64 | 0.10 | 0.02 | 0.01 |
| **Processing technique (pellets)** | | | | | | |
| 0% | 3197 [a] | 5293 [a] | 8298[a] | 2.74 [a] | 2.20 | 2.33 [a] |
| 10% | 2625 [b] | 5097 [b] | 7722 [b] | 2.01 [b] | 2.11 | 2.08 [b] |
| 20% | 2175 [c] | 5033 [c] | 7209 [c] | 1.59 [c] | 2.08 | 1.91 [c] |
| 40% | 2160 [c] | 4947 [d] | 7107 [d] | 1.60 [c] | 2.09 | 1.91 [c] |
| ±SE | 15.80 | 38.54 | 43.00 | 0.01 | 0.02 | 0.01 |
| **Sprouting barley grains** | | | | | | |
| 0% | 3040 [d] | 5453 [c] | 8493 [d] | 2.73 [a] | 2.34 [a] | 2.47 [a] |
| 10% | 3197 [a] | 5583 [a] | 8780 [a] | 2.36 [b] | 2.21 [b] | 2.26 [b] |
| 20% | 3180 [b] | 5558[a] | 8738[b] | 2.17 [c] | 2.22 [b] | 2.20 [b] |
| 40% | 3165 [c] | 5495 [b] | 8660 [c] | 2.14 [c] | 2.19 [b] | 2.17 [c] |
| ±SE | 18.69 | 15.97 | 33.29 | 0.01 | 0.05 | 0.01 |

a, b ....Means in the same column in each classification bearing different letters differ significantly ($P \leq 0.05$).

**Table (9):** Effect of barley grains level, enzyme addition, processing technique and sprouting barley grains on some carcass traits of ducklings.

| Treatments | Carcass traits | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Pre-slaughter weight (g))** | **Carcass %** | **Edible giblets* %** | **Abdominal fat %** | **Digestive tract weight (%)** | **Digestive tract length (cm)** | **Cecum length (cm)** |
| **Barley%** | | | | | | | |
| 0% | 4030 | 70.90 [a] | 5.10 | 3.02 | 5.32 [b] | 143.60 [b] | 35.30 [b] |
| 10% | 4010 | 68.70 [b] | 5.30 | 3.13 | 5.46 [a] | 144.10 [a] | 35.80 [a] |
| 20% | 4020 | 65.11 [c] | 5.20 | 2.92 | 5.60 [a] | 144.40 [a] | 36.00 [a] |
| 40% | 4000 | 62.00 [d] | 5.00 | 2.85 | 5.73 [a] | 145.00 [a] | 36.10 [a] |
| ±SE | 15.00 | 3.52 | 0.18 | 0.01 | 0.29 | 3.00 | 2.25 |
| **Enzyme addition (1g/kg diet)** | | | | | | | |
| 0% | 4020 | 71.22 [a] | 5.60 | 3.21 | 5.11 | 141.20 | 34.00 |
| 10% | 4010 | 71.60 [a] | 5.43 | 3.16 | 5.00 | 141.00 | 34.20 |
| 20% | 4050 | 70.00 [b] | 5.20 | 3.02 | 5.09 | 139.50 | 32.70 |
| 40% | 4040 | 68.00 [c] | 5.31 | 3.00 | 5.22 | 139.80 | 32.00 |
| ±SE | 36.00 | 4.21 | 0.02 | 0.10 | 0.11 | 1.55 | 1.02 |
| **Processing technique (pellets)** | | | | | | | |
| 0% | 4010 | 71.60 [a] | 5.52 [a] | 3.20 | 5.08 | 141.30 | 34.10 |
| 10% | 4030 | 71.82 [a] | 5.21 [a] | 3.05 | 5.00 | 141.46 | 34.30 |
| 20% | 4020 | 70.20 [b] | 5.00 [b] | 3.00 | 5.00 | 141.00 | 34.40 |
| 40% | 4040 | 68.50 [c] | 4.85 [b] | 3.10 | 4.90 | 140.80 | 34.00 |
| ±SE | 25.00 | 1.02 | 0.10 | 0.01 | 0.02 | 0.80 | 0.50 |
| **Sprouting barley grains** | | | | | | | |
| 0% | 4030 | 70.90 [b] | 5.10 | 3.02 [a] | 5.32 [a] | 143.60 [a] | 35.30 [a] |
| 10% | 4050 | 72.00 [a] | 5.26 | 2.80 [a] | 4.90 [a] | 142.00 [b] | 34.40 [b] |
| 20% | 4020 | 71.98 [a] | 5.20 | 2.45 [b] | 4.78 [b] | 141.30 [c] | 34.20 [b] |
| 40% | 4040 | 71.80 [a] | 5.00 | 1.89 [c] | 4.65 [b] | 141.00 [c] | 33.50 [c] |
| ±SE | 30.00 | 0.60 | 0.10 | 0.01 | 0.70 | 2.00 | 0.30 |

* Edible giblets = liver, heart and gizzard weights. a, b ....Means in the same column in each classification bearing different letters differ significantly (P≤0.05).

**Table (10):** Effect of barley grains level, enzyme addition, processing technique and sprouting barley grains on economic evaluation of ducklings.

| Treatments | | Economic evaluation | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Feed conversion ratio | Cost of Kg feed (LE) | Feed cost of kg meat (LE) | Market price of one Kg meat (LE.) | Net return (LE).* | Economic efficiency % (Ee) of feed ** | Relative economic efficiency of feed*** |
| Barley% | 0% | 2.47 | 5.25 | 12.97 | 50.00 | 37.03 | 0.74 | 100 |
| | 10% | 2.62 | 5.35 | 14.02 | 50.00 | 35.98 | 0.72 | 97 |
| | 20% | 2.71 | 5.57 | 15.09 | 50.00 | 34.91 | 0.70 | 94 |
| | 40% | 3.24 | 6.11 | 19.80 | 50.00 | 30.20 | 0.60 | 82 |
| Enzyme (1g/kg.diet) | 0% | 2.43 | 5.35 | 13.00 | 50.00 | 37.00 | 0.74 | 100 |
| | 10% | 2.19 | 5.45 | 11.94 | 50.00 | 38.06 | 0.76 | 103 |
| | 20% | 2.24 | 5.67 | 12.70 | 50.00 | 37.30 | 0.75 | 100 |
| | 40% | 2.49 | 6.21 | 15.46 | 50.00 | 34.54 | 0.69 | 93 |
| Processing technique (pellets) | 0% | 2.33 | 5.4 | 12.58 | 50.00 | 37.42 | 0.75 | 100 |
| | 10% | 2.08 | 5.5 | 11.44 | 50.00 | 38.56 | 0.77 | 103 |
| | 20% | 1.91 | 5.72 | 10.93 | 50.00 | 39.07 | 0.78 | 104 |
| | 40% | 1.91 | 6.26 | 11.96 | 50.00 | 38.04 | 0.76 | 102 |
| Sprouting barley grains | 0% | 2.47 | 5.25 | 12.97 | 50.00 | 37.03 | 0.74 | 100 |
| | 10% | 2.26 | 5.07 | 11.46 | 50.00 | 38.54 | 0.77 | 104 |
| | 20% | 2.2 | 5.1 | 11.22 | 50.00 | 38.78 | 0.78 | 105 |
| | 40% | 2.17 | 5.1 | 11.07 | 50.00 | 38.93 | 0.78 | 105 |

*Net return price of one Kg meat (LE.)- Cost of Kg feed (LE)
**Economic efficiency %= Net return/ price of one Kg meat (LE.)
***Relative economical efficiency% of the control, assuming that relative EE of the control = 100.

## REFRENCES

**Allosio-Ouarnier N., B. Quemener, D.Bertrand and P.Boivin 2000.** Application of High Performance Anion Exchange Chromatography to the Study of Carbohydrate

Changes in Barely during Malting. J Inst Brew, 106: 45-52.

**Almirall M., M. Francesch, A.M. Perez-Vendrell, J. Brufau and E. Esteve-Garcia 1995.** The differences in intestinal viscosity produced by barley and glucanase alter digesta enzyme activities and ileal digestibilities more in broiler chicks than in cocks. J. Nutrition, 125: 947-955.

**Amal B.K, Z. Aurang,B. Nizakat, A.K. Shahid and .K.Mohammad2007.** Influence of germination techniques on phytic acid and polyphenols content of chickpea (Cicer arietinum L.) sprouts. Food Chem. 104: 1074-1079.

**Ankrah, N.O., Campbell, G.L., Tyler, R.T., Rossenagel,B.G. and Sokhansanj, S.R.T. 1999.**Hydrothermal and β-glucanase effects on the nutritional and physical properties of starch in normal and Waxyhull-less barley. Animal Feed Science and Technology, 81: 205 – 219.

**AL-Saadi M.J. and A. H.Ibrahim 2016** Effects of Substitution Barley By 10%, 30% of Sprouted Barley on Rumen Characters, Digestibility and Feed Efficiency in Diet of Awassi Male Lambs. International Journal of Science and Research, 5 (4):2228-2233.

**Bamgbose, A.M., Ogunbenro, S.D., Obasohan, E.E.,Aruna, M.B., Oteku, I.T., Igene, U.F., Otoikhian, C. S.O. and Imasuen, J.A. 2004.** Replacement value of maize offal/cashew nut for maize.Proceedings of 29th Annual Conference of Nigerian Society for animal Production (NSAP), March 21st – 25th Usman Danfodio University, Sokoto,Nigeria. P.: 219 – 221.

**Bedfod, M.R., 2000**. Reduced viscosity of intestinal Marquardt, R.R., 2000. Enzyme enhancement of digesta and enhanced nutrition digestibility in chicken given exogenous enzyme in Enzymes in Poultry and Swine Nutrition edited by Ronald R. Marquardt and Zhengkang Han. IDRC. CRDI Publishing.

**Boguhn, J., and M. Rodehutscord. 2010.** Effects of nonstarch polysaccharide-hydrolyzing enzymes on performance and amino acid digestibility in turkeys. Poult. Sci.89:505–513.

**Dastar B., A.Moghaddam, M.Shargh and S.Hassani (2014).** Effect of different levels of germinated barley on live performance and carcass traits in broiler chickens. Poult. Sci. J., 2 (1): 61-69.

**Duncan, D.B. 1955.** Multiple ranges and multiple F- test. Biometrics, 11: 1-42.

**Dusel, G., H. Kluge, K. Glaeser, O. Simon, G. Hartmann, J. V. Lengerken and H. Jeroch, 1997.** An investigation into the variability of extract viscosity of wheat relationship with the content of non-starch-polysaccharide fractions and metabolisable energy for broiler chickens. Arch. Anim. Nutr. 50, 121 - 135.

**El-Nahas, E.M., A.S.El-Habbaa, G.F. El-Bagouryand M.E.I. Radwan, 2011.** Isolation and identification of lumpy skin disease virus from naturally infected buffaloes at Kaluobia, Egypt. Global Veterinaria, 7: 234-237

**Gandon C., 1995.** Non-starch Polysaccharides of barley and triticale, study on the factor of variation. Dissertation INSA Lyon-ITCF, pp: 102.

**Helal H. G. 2015.** Sprouted Barley Grains on Olive Cake and Barley Straw Mixture as Goat Diets In Sinai. Advances in Environmental Biology, 9(22) : 91-102.

**Hong, D., H. Burrows, and O. Adeola. 2002.**Addition of enzyme to starter and grower diets for ducks. Poult. Sci. 81:1842–1849.

**IFAD (International Fund for Agricultural Development) 2008.** Enabling poor rural people to overcome poverty. Annual Report .177 p. Rome, Italy.

**Jadhav, N.V. and Siddiqui, M.F. 2010.** Handbook of poultry production and management. 2nd ed. Jaypee Brothers Medical publishers Ltd. New Delhi, India 383pp.

**Juanpere, J., A. M. Pérez-Vendrell, E. Angulo,and J. Brufau. 2005.**

Assessment of potential interactions between phytase and glycosidase enzyme supplementation on nutrient digestibility in broilers. Poult. Sci. 84:571–580.

**Khidr, R.E.,A.Z. Soliman and N.A. El-Shoukiery, 2005**. Effect of using date stone meal without or with kemzyme supplementation on productive performance and carcass characteristics of growing turkey.Egyptian Journal. of Desert Research, 55: 1-18.

**Maisonner, S., J. Gomez and B. Carre, 2001.** Nutrient digestibility and intestinal viscosities in broiler chickens fed on wheat diet as compare to maize diet with added guar gum. Br. Poult. Sci., 42: 102- 110.

**Mehri M, Pourreza J and Sadeghi G 2009.** Replacing maize with pearl millet in laying hens diets. Tropical animal health and production. 42 (3):439-444

**Mohammadi, F., Thanaa and M.M. F. AbdalLah, 2007**. Effect of four seed sprouts on rice straw and spent mushroom media of rice straw to be used as a green fodder. Egyptian J. Nutrition and feeds, 10 Special Issue: 679-691.

**Moghaddam AS, Mehdipour M and Dastar B2009.**The Determining of Digestible Energy and Digestibility Coefficients of Protein, Calcium and Phosphorus of Malt (Germinated Barley) in Broilers. Int. J. of Pou. Sci., 8 (8): 788-791

**Mona M.Hassan and S.E.El-Sheikh 2010.** Effect of physical form of diets on the performance of ducks. Egypt.Poult. Sci. 30(4):989-1002.

**Mona M. Hassan, S.E.M. El-Sheikh, A.A. Salama1 and M. El-Saeed 2015.** Utilization of Some Single Cell Protein Sources on Ducks Rations under Heat Stress Condition in Sinai Region. Advances in Environmental Biology, 9(22) Special 2015, Pages: 138-143

**Naik, P.K.; B.K. Swain and N.P. Singh 2015.**Production and utilization of hydroponics fodder. Indian Journal of Animal Nutrition. 32: 1-9.

**Osman. A. M. A.; M. A. H. Soliman; Kout El Kloub M. EL.Mostafa and Eman T. S. Osman. 2018.** Effect of using germinated barley and commercial enzymes mixture on broiler performance. Minia J. of Agric. Res. & Develop. Vol. (38), No. 4, pp. 587-605.

**Peer, D. J., and S. Leeson. 1985.**Nutrient content of hydroponically sprouted barley. Anim. Feed Sci. Technol.13:191–202.

**Pettersson, D. H. G., and P. Åman1991.** The nutritive value for broiler chickens of pelleting and enzyme supplementation of a diet containing barley, wheat and rye.Anim. Feed Sci. Technol. 33:1–4.

**Rodríguez, M. L., A. Rebolé, S. Velasco, L. T. Ortiz, J. Treviño, and C. Alzueta. 2012.** Wheat- and barley-based diets with or without additives influence broiler chicken performance, nutrient digestibility and intestinal microflora. J. Sci. Food Agric. 92:184–190.

**Salih M.E., Classen H.L., Campbell G.L. 1991.** Responses of chickens fed on hulless barley to dietary β-glucanase at different ages. Anim. Feed Sci. Technol., 33, 139–149.

**Shewry, P.R., J.A. Napier, and A.S. Tatham 1995.** Seed storage proteins: structures and biosynthesis. The Plant Cell 7: 945-956.

**Shipard, I. 2005.** How can I grow and use sprouts as living food? Stewart publishing.

**Smits, C. H. M., and G. Annison. 1996.** Non-starch plant polysaccharides in broiler nutrition—Towards a physiological valid approach to their determination. World’s
Poult. Sci. 52:203–221.

**Smits C.H.M., Veldman A., Verstegen M.W.A and A.C. Beynen 1997.** Dietary carboxymethylcellulose with high instead of low viscosity reduces macronutrient digestion in broiler chickens. J. Nutr., 127, 483–487.

**S.A.S. 2002.** Statistical Analysis System, User’s Guide, Statistics, SAS Institute Carry, North Carolina.

**Stef L., D. Drinceanu, G. Dumitrescu, C. Julean and D. Stef 2011.**Changes of intestine dimensions determined by barley and wheat-based non starch polysaccharides (NSP) in broilers. Animal Sci. and Biotechnology ,44 (1).

**Sundu B, A Kumar and J. Dingle 2005**.Response of birds fed increasing levels of palm kernel meal supplemented with enzymes. Proceedings of the 17th Australian Poultry Science Symposium; February 7–9, 2005; Sydney, New South Wales, Australia.. pp. 227–228.

**Sundu, B., A. Kumar and J. Dingle, 2008**. The effect of proportion of crumbled copra meal and enzyme supplementation on broiler growth and gastrointestinal development. Int. J. Poult. Sci., 7:511-515.

**Svihus B, Newman RK and** CW **Newman . 1997** Effect of soaking, germination, and enzyme treatment of whole barley on nutritional value and digestive tract parameters of broiler chickens. Br Poult Sci. 1997 Sep;38(4):390-396.

**Thacker PA 2013.** Alternatives to antibiotics as growth promoters for use in swine production: a review. Journal of Animal Science and Biotechnology 4: 35.

**Yasar, S., and J. M. Forbes. 1999.** Performance and gastro-intestinal response of broiler chickens fed on cereal grain-based foods soaked in water. Br. Poult. Sci.40:65–76.

**Barley – enzyme - pelting –sprouting – Ducks.**

## الملخص العربى

## تحسين الاستفادة من حبوب الشعير كمصدر للطاقة في علائق البط تحت ظروف منطقة جنوب سيناء

**منى محمد على حسن**

قسم تغذية الحيوان و الدواجن، مركز بحوث الصحراء، القاهرة، مصر

تهدف الدراسة الحالية الي كيفية تحسين الاستفادة من حبوب الشعير وتاثير ذلك على اداء البط ، صفات الذبائح و الكفاءة الاقتصادية،حيث استخدم عدد 450 كتكوت بط مسكوفي عمر 7 ايام قسمت الي 15 مجموعة تجريبية تضمنت اربعة مستويات من حبوب الشعير وهي10,0, 40,20 % ، اربعة مستويات الشعير السابقة مع تدعيمها ب 1 جم من الانزيم / كجم , اربعة مستويات الشعير السابقة بعد اجراء عملية التصنيع لها في صورة مكعبات، ثلاثة مستويات من الشعير المستنبت 10و20و40% مقارنة بالعليقة الكنترؤل التقليدية.

.أظهرت النتائج أن:

-ادت زيادة مستوى حبوب الشعير فى علائق البط الى زيادة في كمية السكريات غير القابلة للذوبان وبالتالي زيادة لزوجة الامعاء، انخفاض معاملات الهضم والقيمة الغذائية، انخفاض الوزن الحي ، زيادة الماكول مع زيادة معدل التحويل الغذائي، انخفاض % صفات الذبائح ، اعلى قيمة للكفاءة الاقتصادية والكفاءة الاقتصادية النسبية (97%) للغذاء كانت للمعاملة المحتوية على 10% شعير.

- ادت اضافة الانزيم الي العلائق التجريبية الى خفض قيم السكريات غير القابلة للذوبان وبالتالي انخفاض قيم لزوجة الامعاء ،تحسن معاملات الهضم والقيمة الغذائية، تحسن الوزن الحي ومعدل التحويل الغذائي، تحسن % صفات الذبائح، اعلى قيمة للكفاءة الاقتصادية والكفاءة الاقتصادية النسبية (103%) للغذاء كانت للمعاملة المحتوية على 10% شعير مع تساوي معاملة 20% شعير والكنترول في قيمة والكفاءة الاقتصادية النسبية (100%).

- ادت استخدام تقنية تصنيع العليقة في صورة مكعبات الى خفض قيم السكريات غير القابلة للذوبان وبالتالي انخفاض قيم لزوجة الامعاء ،تحسن معاملات الهضم والقيمة الغذائية، تحسن الوزن الحي ومعدل التحويل الغذائي ليتفوق على عليقة الكنترول المصنعة ، تحسن % صفات الذبائح، اعلى قيمة للكفاءة الاقتصادية والكفاءة الاقتصادية النسبية (104%) للغذاء كانت للمعاملة المحتوية على 20% شعير .

-ادت استخدام تقنية الاستنبات لحبوب الشعير الي افضل القيم من حيث خفض قيم السكريات غير القابلة للذوبان وبالتالي انخفاض قيم لزوجة الامعاء ، اعلى تحسن لمعاملات الهضم والقيمة الغذائية،اعلى تحسن للوزن الحي ومعدل التحويل الغذائي لتسجل الطيور المغذاه على 40% شعير مستنبت اعلى اوزان مع افضل قيمة لمعدل التحويل الغذائي ، تحسن % صفات الذبائح، اعلى قيمة للكفاءة الاقتصادية والكفاءة الاقتصادية النسبية (105%) للغذاء كانت للمعاملة المحتوية على 20% او 40% من الشعير المستنبت .

وبصفة عامة: انه يمكن استنتاج ان تقنية استنبات حبوب الشعير هي افضل الطرق لتحسين الاستفادة من حبوب الشعير بدون اي اثار سلبية على اداء البط .