IJASVM

International Journal of Agricultural Sciences and Veterinary Medicine

ISSN : 2320-3730

Vol. 6, No. 1, February 2018

www.ijasvm.com

E-Mail: editorijasvm@gmail.com or editor@ijasvm.comm@gmail.com

International Journal of Agricultural Sciences and Veterinary Medicine

ISSN 2320-3730 www.ijasvm.com
Vol. 6, No. 1, February 2018

Research Paper

FEEDING VALUE OF HYDROPONICALLY SPROUTED BARELY FOR BROILERS

Huthail Najib[1*] and Suliman Al-Khateeb[2]

*Corresponding Author: Huthail Najib, ✉ huthailn@yahoo.com

Received on: 15th January, 2018 Accepted on: 25th January, 2018

Sprouting grains causes increased activities of hydrolytic enzymes, improvements in the contents of total proteins, fat, certain essential amino acids, total sugars, B-group vitamins, and a decrease in dry matter, starch and anti-nutrients. Barely is known for its lower energy value than yellow corn and cause digestion problems in chickens. Therefore sprouting barely may help improve the nutritional value of barely and can then be included the broiler diets with no adverse effect. This experiment was aimed to study the effect of using sprouted barely at two stages of germination, replacing 0, 25, 50 and 75% of the corn on the performance and livability of broiler chicks. Eight dietary treatments including 4 treatments of sprouted barely that have been harvested at 2 and 4 days of soaking and four levels of corn replacements were assigned to the batteries where 10 broiler chicks allocated in each (replications). Results of the study showed that 4-day sprouted barely has more protein, crude fat, crude fiber and higher energy. Better body weight was achieved when 2-day sprouted barely was fed replacing 50% of the corn and when 4-day sprouted barely was fed replacing 25% of the corn. However, the control overwhelmed these results. It is concluded that despite the high fiber, especially in 4 days germination, sprouted barely may be added to the poultry diets with caution.

Keywords: Barely, Sprouting, Broilers, Germination time

INTRODUCTION

Poultry feed represent the largest portion of production cost which impose a heavy financial burden on the producer which at the end he is forced to raise the prices of the poultry products. The victim in this case is the consumer which he has to pay extra to buy poultry products. Since yellow corn represents about 70% of the poultry ration and their prices are unstable and connected with the country of origin prices and also may disappear from the market for some reason or other therefore the search for a replacement becomes a necessity. Nutrition of barely has been always a target for ruminants producer's due to availability and cheaper prices but this was not the case in poultry. Barely is lower in energy than

[1] Department of Animal and Fish Production, King Faisal University, Faculty of Agriculture & Food Sciences, P.O. Box 420, Saudi Arabia.

[2] Department of Environment and Natural Agricultural Resources, King Faisal University, Faculty of Agriculture and Food Sciences, P.O. Box 420, Saudi Arabia.

yellow corn and cause digestion problems in chickens. In addition, the presence of glucagon in cell wall of barely may be the reason for the viscosity of the intestinal content which at the end will slow down the rate digesta passage and deteriorate the interaction between nutrients and enzymes which at the end lower the digestibility of the food (Annison, 1993; Fuente, 1998; and Moghaddam, 2009). Therefore researchers started searching for ways to improve the digestibility of barely in Poultry (Annison, 1993; and Fuente, 1998).

More than 1400 years ago the great Holly Quran provided evidences that nutrients in barley and wheat multiplied 60 times when seeds are germinated. Scientists in Wisconsin believes that sprouted barley and wheat contains special growth factor not even existed in milk.

Several researchers have investigated the feeding value of field-sprouted grain for poultry. Bull and Peterson (1969), Farlin (1971), Roland (1978) and Sibbald (1962) found no difference in performance of birds fed on sprouted or non-sprouted grain. In contrast Falen and Peterson (1969) reported an increase in metabolizable energy content of wheat when the diet contained a combination of sprouted and non-sprouted grain. Chavan and Kadam (1989) state that, "Sprouting grains causes increased activities of hydrolytic enzymes, improvements in the contents of total proteins, fat, certain essential amino acids, total sugars, B-group vitamins, and a decrease in dry matter, starch and anti-nutrients. Chavan and Kadam (1989) state that, "Sprouting grains causes increased activities of hydrolytic enzymes, improvements in the contents of total proteins, fat, certain essential amino acids, total sugars, B-group vitamins, and a decrease in dry matter, starch and anti-nutrients. The increased contents of protein, fat, fiber and total ash are only apparent and attributable to the disappearance of starch. However, improvements in amino acid composition, B-group vitamins, sugars, protein and starch digestibility, and decrease in phytates and protease inhibitors are the metabolic effects of sprouting process. Overall nutritional improvement upon sprouting is of smaller magnitude and not often accounted for in animal feeding experiments."

Lorenz (1980) stated that the sprouting of grains causes increased enzyme activity, a loss of total DM, an increase in total protein, a change in amino acid composition, a decrease in starch, increases in sugars, a slight increase in crude fat and crude fiber, and slightly higher amounts of certain vitamins and minerals. Most of the increases in nutrients are not true increases; they simply reflect the loss of DM, mainly in the form of carbohydrates, due to respiration during sprouting. As total carbohydrates decreases, the percentage of other nutrients increases. Chung (1989) found that the fiber content increased from 3.75% in un-sprouted barley seed to 6% in 5-day sprouts

OBJECTIVES

1. Determine the chemical content of hydroponically-sprouted barley.
2. Study the effect of sprouting time on broiler chickens performance.
3. Study the effect of replacing different levels of hydroponically-sprouted barley, with corn on broiler chickens performance and livability.

MATERIALS AND METHODS

Barley were sprouted hydroponically for 2 and 4 days from sowing under controlled conditions in the premises of Germination House

Establishment of Saudi Arabia. Germinated or sprouted barely were dried and ground and then added to the broiler rations.

Moisture, crude fat, protein, ash and acid and crude fibers were determined using standard analytical procedures (AOAC, 2000). Determination of Amino Acids as described in 996.01 AOAC was done using, amino acid analyzer (model Biochrom 20, Amershan Pharmcia, Cambridge, UK).

True Metabolizable Energy (TME) Determination

TME of the sprouted barely was determined upon harvesting according to the method developed by Sibbald (1976). Three Cockerels for each group were numbered by tags, weighed and housed individually in cages and starved for 48 hours before being forcibly fed 40 gm of the ground meal. Water was given ad-libitum during that period. Birds were weighed again before feeding. Two cocks were left unfed as a control. The funnel containing the ground sprouted barely meal was pushed down the esophagus of the cock until the end of the crop is reached. The birds fed sprouted barely and those kept unfed (control) were placed in cages and excreta voided was collected quantitatively after 48 hours using plastic sheets (Schang and Hamilton, 1982). Birds were weighed again at this time. The collected feces from fed and un-fed birds were dried at 54 °C for 48 hours in an oven due to the watery texture of the feces. The feces were then weighed and left outside the oven to equilibrate with atmospheric moisture. Ground samples from both types of yeast and excreta collected were assayed for gross energy using a diabatic oxygen bomb calorimeter (AOAC, 2000).

Experimental Procedure

A 2 x 4 factorial design experiment was conducted to achieve the objectives of the study. After two and 4 days of germination, the Sprouted Barely replaced 0, 25, 50 and 75% of the corn in the broiler diet.

Two hundred eighty day-old chicks were randomly distributed intermingled in to 28 battery pens, each contained 10 chicks. These battery pens were equipped with a source of heat, feeders and waterers. Eight dietary treatments including 4 treatments of sprouted barely that were harvested at 2 and 4 days of soaking. These treatments were assigned to the batteries in such a way that each dietary treatment was assigned to 4 battery pens (replications). The Basal diets were formulated to meet or exceed NRC (1994) recommendations. The experimental diets (Table 1) were formulated to be iso-nitrogenous and iso-caloric. They were fed to the birds starting from week 2 of age.

The trial was conducted in a broiler house where cooling devices are being installed. The experimental diets and drinking water were offered ad libitum. A photoperiod of 20 h/day was maintained.

Birds were weighed individually every week and weight gain was determined according to that. Feed was added, as necessary and weekly and cumulative feed intake were determined from feed left as opposed to feed given. Weekly mortality was calculated based on the number of birds that died in a specific day of the week. Four birds, two males and two females, from each treatment were sacrificed for dressing analysis. The experiment lasted 45 days. TME values and other values obtained from the chemical analysis were used to formulate the dietary treatments. Rations were mixed according to the required treatments to the nearest gram as follows: Micro ingredients were carried with 3 kg yellow corn and mixed well

Table 1: Dietary Treatments of Broilers Fed Different Levels of Germinated Barely								
Ingredients	**2-Day Germination**				**4-Day Germination**			
Yellow Corn, %	60	45	30	15	60	45	30	15
SBM, 44 %	30	30	30	30	30	30	30	30
Wheat Bran, %	0	0	0	0	0	0	0	0
Fish Meal, %	4.5	3.72	2.95	2.17	4.5	3.73	2.95	2.16
Lime Stone, %	1.36	1.32	1.27	1.27	1.36	1.21	1	1
MVMIX[1]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
DL. Methionine	0.25	0.25	0.25	0.24	0.25	0.25	0.37	0.37
DIC. Phosphate	0.6	0.6	0.6	0.6	0.6	0.6	1	1
L-LYSINE	0	0	0	0	0	0	0.05	0.05
Choline -CL	0	0	0	0	0	0	0	0
Salt, %	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Veg. Oil, %	2.69	3.51	4.33	5.15	2.69	3.61	4.53	5.46
Antioxidant, %	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Barley 2	0	15	30	45	0	0	0	0
Barley 4	0	0	0	0	0	15	30	45
Total	**99.9**	**100**	**100**	**100.03**	**100**	**100**	**100.5**	**100.64**
Calculated Composition								
Protein, %	21	21	21	21	21	21	21	21
ME, Kcal/Kg	3100	3050	3050	3050	3050	3050	3050	3050
Calcium, %	0.96	1.01	0.97	0.95	1.04	0.97	0.96	0.94
Av-phos., %	0.41	0.4	0.35	0.3	0.45	0.4	0.42	0.42
Riboflavin, mg/kg	1.88	1.96	2	2.04	1.92	1.96	2	2.04
Niacin, mg/kg	26.84	22.96	18.64	14.32	27.29	22.97	18.64	14.31
PA, mg/kg	7.98	7.23	6.5	5.77	7.97	7.23	6.5	5.77
Choline, mg/kg	1441	1315	1478	1492	1449	1315	1181	1046
Methionine, %	0.56	0.56	0.57	0.55	0.61	0.56	0.63	0.66
Met + Cys, %	0.87	0.85	0.91	0.9	0.92	0.85	0.89	1.01
Lysine, %	1.24	1.17	1.22	1.21	1.25	1.17	1.15	1.26
Tryptophan, %	0.31	0.29	0.31	0.31	0.31	0.29	0.27	0.31
Threonine, %	1.43	0.81	0.8	0.79	0.82	0.81	0.8	0.79
Linoleic Acid, %	3.08	2.8	3.02	3.19	2.69	2.85	3.01	3.34

Note: [1] The multi vitamin-minerals premix provide the following per Kg of diet: 7000 IU, vit A; 1500 ICU, vit D3; 30 IU, vit E; 50 mg, vit C; 2.3 mg, vit K; 1.8 mg, vit B1; 5.5 mg, vit B2; 2.3 mg, vit B6; 0.011 mg, vit B12; 27.6, mg Niacin; 0.92 mg, Folic acid; 6.9 mg, PA; 0.092 mg, Biotin; 50 mg, Antioxidant (BHT); 8 mg, copper; 0.35 mg, Iodine; 0.26 mg, Iron; 0.44 mg, Manganese; 0.18 mg, Selenium; 44 mg, Zinc.

in a small mixer (3.5 kg capacity). This amount was then mixed with the rest of the ingredients in a larger mixer (80 kg capacity). The ingredients and calculated composition of the nutrients are shown in Table 1.

Variables Measured

Individual body weights of all chicks were measured at the beginning of the experiment and continued as such on a weekly basis. As a result, body weight gain was calculated based on the differences between the body weights. Feed consumption per bird was measured from feed added and feed left. Weekly and cumulative feed efficiency were calculated based on weekly or cumulative feed consumption. Mortality was calculated as a percentage of birds alive in a certain day and cumulative mortality was considered as well. The experiment lasted 45 days.

At the end of the experimental period, 6 birds were selected from each treatment group, weighed and slaughtered to determine some digestive system characteristics. After evisceration, heart, liver and the heart were weighed as a group. Dressing percentage was expressed as percentage of both live weight and dressed weight.

Statistical Analysis

All data were subjected to analysis of variance in the general linear model using the statistical Analysis System software SAS (2008). Differences among treatments when significant ($P<0.05$) were estimated using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical Analysis of the Hydroponically Sprouted Barely

Analysis of the 2-day sprouted barely, revealed that the metabolizable energy of the 2-day germinated barely was 2962 kilocalories/Kg, 4.6% moisture, 11.31% crude protein, 1.84% fat, 7.93% fiber, 3.53% ash. While 4-day sprouted barely contained 2922 Kilocalories/kg ME, 5.85% moisture, 12.09% crude protein, 2.84% fat, 10.24% fiber and 4.06% ash (Table 2). The relatively lower content of energy in the 4-day sprouted barely comparing to the 2-day sprouting could be due to the higher content of fiber in 4-day sprouted barely. These results agreed with the work of Peer and Leeson (1985a) who demonstrated that 4-day sprouted barely has more energy (3389 Kilocalories/Kg ME) while barely sprouted for 6 days has 2838 Kilocalories/Kg ME) as Frazaeli (2012) has also reported. Crude protein in 2-day sprouted barely was about 11.31% and about 12.09% for 4-day sprouted barely which indicate that longer sprouting days increases the protein content of barely. These were lower than those reported earlier, 15% CP in 4-day germination (Peer and Leeson, 1985b) and 13.7% for 6-days germination (Fazaeli, 2012). Moisture content results did not agree with Peer and Leeson (1985) whom they reported a 10% content while this study showed a 4.6% for the 2-days germination and 5.85% for the 4-days

Table 2: Chemical Analysis of Hydroponically Sprouted Barely

% Nutrients	Day Sprouting-4	Day Sprouting-2
Moisture	5.85	4.6
Crude Protein	12.059	11.31
Crude Fat	2.84	1.84
Crude Fiber	10.24	7.93
Crude Ash	4.06	3.53
ME, Kcal/kg	2995	2922

germination. Fat was also higher in the 4-days germination in this study (2.84%) and 1.84% fat for the 2-days germination. Chemical analysis of the sprouted barely has also shown that ash content in the 2-day sprouting was 3.53% while was 4.06% for the barely sprouted for 4 days. All these results showing the higher content of nutrients in the 4-day barely provided evidence that sprouting increase the nutrient content of the barely and would improve the performance of the birds, however this was not the case in this study and others due to the higher content of crude fiber 10.24% for the 4-days sprouting and 7.93% in the 2-days hydroponically sprouting barely. A 22% more fiber is present in the 4-day sprouted barely. Chung (1989) showed lower CF in in 5-days sprouted barely.

Performance of the Broilers During Week 5 of Growth

The data in Table 5 showed that with exception of week 5, treatments were not affected by the interaction pertaining to body weight, body weight gain and livability. I am not surprised at these results since that effect of these treatments may need some time before they show any effect on the birds. Sine week 5 is the week when the birds are marketed therefore, showing an effects at this time may change the decision of marketing. It is clear from the table the control overwhelmed other treatments in body weight and body weight gain. If we exclude the control from the equation it seemed that 50% replacement of 2 days germinated barely had better weight of birds comparing to the other treatments, however they don't seem very much different from the combination of 25% replacement and 4 days germination. Despite The lower daily consumption of the control (Table 3) body weight of the birds were the highest (Table 3). This could be due to the higher content of the fiber in the sprouted barely. The control diet has no barely. Chung (1989) found that the fiber content increased from 3.75% in un-sprouted barley seed to 6% in 5-day sprouts. As level of barely increased in the ration there was a gradual decrease in body weight (Table 3). The relatively lower consumption of the control birds was reflected on cumulative feed conversion. It was evident that best feed conversion in week 5 was found with the control group (Table 3).

Body weight gain is an excellent way of determining the best time to market broilers. Weight gain normally increases by time reaching its peak and then started to decrease. The point (week) where body weight started to fall may be considered the week to market the birds. This may not be true in every cases since so many factors may affect the decision of marketing. Figure 1 is showing the weight gain trend during the weeks of the experiment. With the exception of treatment 4 and 3, week 4 is the optimum week to sell the birds. Treatment 3 and 4 may have been affected by the higher fiber content of the sprouted barely which usually slows down the growth rate of the birds. Similar picture is shown in Figure 2 when more time was given to sprouting. This would naturally increases the fiber content of the barely (4-days germination). Weekly feed intake and cumulative feed intake were not significantly affected neither by the interaction nor by each factor independently. On the other hand feed conversion either weekly or cumulative were significantly affected by the interaction which probably suggest that the effect of body weight was more pronounced on feed efficiency than the non-significant feed intake.

Table 3: Performance of Broilers Fed Different Levels of Germinated Barely[1]

Traits	Replacement Level, %	Weeks in Experiment				
		1	2	3	4	5
Body weight, gm	0	163.9^{a}	276.8^{a}	513.9^{a}	1188.1^{a}	1699.4^{a}
	25	143.6^{b}	254.2^{ab}	456.2^{ab}	1055.5^{b}	1476.4^{b}
	50	128.5^{c}	227.6^{bc}	432.5^{b}	959.9^{b}	1486.8^{b}
	75	120.6^{c}	213.6^{c}	424.8^{b}	825.2^{c}	1280.1^{c}
	P =	**<0.0001**	**0.0057**	**0.0264**	**<0.0001**	**<0.0001**
Body weight gain, gm	0	129.6^{a}	112.9^{a}	237.1^{a}	674.2^{a}	577.3^{a}
	25	107.4^{b}	110.6^{a}	202.0^{a}	599.2^{ab}	420.9^{c}
	50	92.9^{cb}	99.1^{a}	204.9^{a}	527.4^{bc}	534.9^{ab}
	75	85.0^{c}	95.0^{a}	222.5^{a}	400.5^{c}	463.9^{bc}
	P =	**<0.0001**	**0.5002**	**0.7016**	**0.0025**	**0.0033**
Daily feed intake, gm	0	24.86^{ab}	40.95^{a}	42.98^{a}	68.94^{a}	100.4^{a}
	25	23.96^{b}	40.61^{a}	41.64^{ab}	68.35^{a}	104.2^{a}
	50	26.14^{ab}	43.54^{a}	36.90^{c}	62.51^{b}	101.6^{a}
	75	26.51^{a}	43.31^{a}	37.95^{bc}	58.26^{b}	104.0^{a}
	P =	**0.1208**	**0.2002**	**0.0133**	**0.0006**	**0.8551**
Cumulative feed intake, gm	0	174.1^{ab}	460.7^{a}	761.7^{a}	1244.2^{a}	1952.0^{a}
	25	167.8b	452.1^{a}	743.6a	1222.0^{ab}	1951.1^{a}
	50	183.0^{ab}	487.6^{a}	745.9^{a}	1183.5^{ab}	1893.6^{a}
	75	185.5^{a}	488.3^{a}	752.1^{a}	1160.0^{b}	1886.1^{a}
	P =	**0.1238**	**0.0963**	**0.7948**	**0.0415**	**0.3884**
Weekly feed conversion kg/kg	0	1.265a	2.541^{a}	2.330^{a}	1.846^{ab}	3.796^{b}
	25	1.395^{b}	2.373^{a}	2.315^{a}	1.766^{b}	3.796^{a}
	50	1.395^{b}	2.495^{a}	2.181^{a}	1.829^{ab}	2.783^{a}
	75	1.434^{b}	2.330^{a}	2.030^{a}	2.094^{a}	2.796^{b}
	P =	**0.001**	**0.9165**	**0.5215**	**0.0747**	**0.0003**
Cumulative feed conversion Kg/kg	0	1.105^{a}	1.711^{a}	1.494^{a}	1.136^{a}	1.163^{a}
	25	1.749^{b}	2.151^{b}	1.821^{b}	1.242^{b}	1.379^{b}
	50	2.128^{b}	2.466^{b}	1.945^{ab}	1.351^{c}	1.341^{b}
	75	2.043^{b}	2.522^{b}	2.138^{c}	1.530^{d}	1.544^{c}
	P =	**0.0003**	**0.001**	**<.0001**	**<0.0001**	**<0.0001**
Livability, %	0	98.66^{a}	99.11^{a}	98.5^{a}	100	100
	25	98.66^{a}	100.0^{a}	100.0^{a}	100	100
	50	98.22^{a}	100.0^{a}	99.7^{a}	100	100
	75	97.99^{a}	100.0^{a}	99.7^{a}	100	100
	P	**0.9707**	**0.4345**	**0.5211**	**na**	**na**

Note: [1] Means that are not carrying the same superscripts are significantly different, P<0.05.

Table 4: Performance of Broilers as Affected by Days of Germination[1]

Traits	Germination Time	Weeks in Experiment				
		1	2	3	4	5
Body weight, gm	2 days	145.1[a]	245.4[a]	474.4[a]	1048.8[a]	1524.3[a]
	4 days	133.2[b]	242.7[a]	439.2[a]	965.6[a]	1444.0[a]
	P =	**0.0245**	**0.9196**	**0.1077**	**0.054**	**0.1754**
Weight gain, gm	2 days	109.5[a]	99.6[a]	236.7[a]	574.4[a]	475.5[a]
	4 days	97.9[b]	109.5[a]	196.6[a]	526.3[a]	524.1[a]
	P =	**0.0416**	**0.2938**	**0.1042**	**0.3083**	**0.0493**
Daily feed intake, gm	2 days	24.89[a]	40.81[a]	39.36[a]	66.11[a]	100.4[a]
	4 days	25.85[a]	43.24[b]	40.38[a]	62.92[a]	104.8[a]
	P =	**0.2413**	**0.0337**	**0.4687**	**0.0834**	**0.1506**
Cumulative feed intake, gm	2 days	174.2[a]	458.9[a]	735.3[a]	1198.0[a]	1901.1[a]
	4 days	180.9a	483.6[b]	766.4[b]	1206.8[a]	1940.0[a]
	P =	**0.2433**	**0.0444**	**0.0338**	**0.6817**	**0.2499**
Weekly feed conversion kg/kg	2 days	1.342[a]	2.639[a]	2.177[a]	1.867[a]	3.411[a]
	4 days	1.382[a]	2.250[a]	2.250a	1.901[a]	2.760[b]
	P =	**0.1403**	**0.0775**	**0.65**	**0.7085**	**0.0003**
Cumulative feed conversion kg/kg	2 days	1.23[1a]	1.868[a]	1.620[a]	1.164[a]	1.267[a]
	4 days	2.282[b]	2.517[b]	2.078[b]	1.465[b]	1.451[b]
	P =	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
Livability, %	2 days	98.55[a]	99.52[a]	99.11[a]	100	100
	4 days	98.21[a]	100.0[a]	99.87[a]	100	100
	P =	**0.7807**	**0.3475**	**0.3401**	**na**	**na**

Note: [1] Means that are not carrying the same superscripts are significantly different, $P<0.05$.

Viscosity of the Digesta

Table 7 shows a non-significant differences among treatments pertaining to the viscosity of the digetsta However, there was a clear indication that viscosity of the digesta was decreased with increasing level of sprouted barely in the diet. Between days of germination , 4 days numerically overwhelmed 2 days of sprouting. Svihus (1997) pointed out that soaking and germinating barely decreases the content of dissolvable beta glucan in barely. As a results viscosity decreased as well. Likewise, Afsarmanesh (2013) indicated that yellow corn can be replaced by germinated barely or wheat in the diet of poultry since they contribute to lower the viscosity of the digesta and decrease villi sizes.

Dressing Analysis

There was no significant differences in any of

Table 5: Interaction of Germination Level and Time of Germination on Feed Intake and Mortality of Broilers Fed Different Levels of Germinated Barely[1]

Traits	Replacement Level, %	Weeks in Experiment				
		1	2	3	4	5
Body weight, gm	Control	166.5±8.5	274.0±25.0	506.8±100.8	1161.5±40	1736±150
	2 * 25	144.8±29.5	254.8±57.4	464.8±8.8	1085.8±38	1403±114
	2 * 50	135.5±16.7	225.5±38.4	459.5±90.6	1035.2±109	1552±156
	2 * 75	133.8±6.08	221.3±25.6	467.5±65.4	912.8±20	1358±69
	Control	161.2±9.0	279.5±23.1	521.0±51.0	1214.8±296	1651±90
	4 * 25	142.5±11.0	253.8±38.5	448.5±43.4	1025.2±37	1550±61
	4 * 50	121.5±10.1	229.8±15.2	405.5±14.0	884.5±37	1405±58
	4 * 75	107.5±4.80	207.8±13.4	382.0±30.7	737.8±47	1222±82
	P =	**0.3415**	**0.9431**	**0.3787**	**0.2189**	**0.0417**
Body weight gain, gm	Control	132.5±7.32	107.5±31.6	232.8±110.8	654.8±94	574.0±153
	2 * 25	107.0±32.7	110.0±33.5	209.2±50.5	621.8±30	317.0±83
	2 * 50	99.5±17.7	90.0±36.5	234.0±76.2	575.8±77	546.6±50
	2 * 75	99.0±7.2	88.0±28.0	270.8±113.6	445.2±80	437.0±76
	Control	126.8±8.6	118.2±23.3	241.5±42.5	693.8±331	581.7±17
	4 * 25	107.8±12.2	111.2±31.9	194.8±10.3	576.8±48	524.8±67
	4 * 50	86.2±11.3	108.2±8.5	175.8±5.7	479.0±27	520.2±48
	4 * 75	71.0±2.6	100.2±12.0	174.2±25.2	355.8±36	484.0±49
	P =	**0.2896**	**0.9403**	**0.4243**	**0.7153**	**0.03**
Livability, %	Control	98.66±2.7	98.22±3.6	96.94±6.1	100.0±0.0	100.0±0.0
	2 * 25	97.32±5.4	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0
	2 * 50	98.22±3.6	100.0±0.0	99.49±1.0	100.0±0.0	100.0±0.0
	2 * 75	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0
	Control	98.66±2.7	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0
	4 * 25	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0
	4 * 50	98.22±3.6	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0
	4 * 75	95.98±4.7	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0
	P =	**0.283**	**0.4345**	**0.4023**	**NA**	**NA**

Note: [1] Means that are not carrying the same superscripts are significantly different, P<0.05.

the criteria measured (Table 8). However on the 10% probability scale, it is observed that replacing corn with 75% sprouted barely had a significantly the lowest dressing percent for

Table 6: Interaction of Germination Level and Time of Germination on Feed Intake Parameters of Broilers Fed Different Levels of Germinated Barely[1]

Traits	Replacement Level, %	Weeks in Experiment				
		1	2	3	4	5
Daily Feed Intake, gm/b/d	Control	24.2±1.6	40.58±2.7	43.68±5.6	71.00±7.7	98.6±8.9
	2 * 25	23.1±4.6	40.60±2.9	38.68±3.0	70.52±5.8	105.7±5.2
	2 * 50	25.6±1.2	42.20±1.8	36.45±1.6	64.30±4.4	99.5±11.2
	2 * 75	26.5±0.4	39.53±5.3	38.62±4.4	58.62±6.1	97.5±13.3
	Control	25.5±1.7	41.32±2.9	42.28±3.3	66.88±5.0	102.9±1.6
	4 * 25	24.8±2.3	40.62±2.2	44.60±0.0	66.18±2.0	102.6±1.0
	4 * 50	26.6±1.2	44.88±3.5	37.35±5.6	60.72±1.3	104.3±7.0
	4 * 75	26.5±2.3	46.15±3.2	37.28±4.2	57.90±4.5	108.5±7.0
	P =	**0.8943**	**0.7213**	**0.2281**	**0.8779**	**0.4062**
Cumulative feed intake, gm	Control	169.9±11.2	453.8±27.0	759.6±32.6	1256.6±80	1947±120
	2 * 25	161.8±32.5	446.0±51.6	716.7±70.1	1210.2±108	1950±144
	2 * 50	179.6±8.40	474.9±15.8	730.0±20.1	1180.0±43	1875±106
	2 * 75	185.6±3.0	461.7±35.7	735.0±5.7	1145.3±48	1819±125
	Control	178.3±12.1	467.6±9.82	763.8±25.4	1231.9±35	1959±37
	4 * 25	173.8±16.4	458.1±30.1	770.6±30.1	1233.8±28	1952±34
	4 * 50	186.3±8.4	500.4±32.1	761.8±14.1	1187.0±11	1917±57
	4 * 75	185.3±16.0	508.3±32.1	769.3±63.4	1174.6±64	1937±113
	P =	0.8885	0.7213	0.6533	0.8051	0.7039
Weekly feed conversion kg/kg	Control	1.257±0.03	2.669±0.5	2.479±0.9	1.805±0.3	3.118±0.5
	2 * 25	1.385±0.16	2.368±0.3	2.327±0.6	1.747±0.02	4.614±1.0
	2 * 50	1.374±0.09	2.864±1.2	2.052±0.4	1.810±0.18	2.841±0.1
	2 * 75	1.353±0.04	2.659±0.7	1.850±0.4	2.106±0.42	3.148±0.4
	Control	1.273±0.02	2.414±0.3	2.182±0.2	1.888±0.42	2.838±0.1
	4 * 25	1.326±0.05	2.378±0.4	2.303±0.2	1.786±0.13	2.978±0.3
	4 * 50	1.416±0.07	2.126±0.1	2.309±0.1	1.848±0.04	2.710±0.2
	4 * 75	1.514±0.02	2.083±0.1	2.208±0.2	2.082±0.14	2.532±0.1
	P =	0.0492	0.5962	0.4767	0.9797	0.0086
Cumulative feed conversion kg/kg	Control	1.078±0.06	1.726±0.2	1.435±0.2	1.112±0.08	1.142±0.1
	2 * 25	1.102±0.06	1.789±0.2	1.534±0.1	1.114±0.06	1.389±0.1
	2 * 50	1.354±0.12	2.028±0.1	1.603±0.1	1.175±0.04	1.227±0.05
	2 * 75	1.390±0.08	1.948±0.2	1.910±0.2	1.256±0.07	1.339±0.1
	Control	1.132±0.10	1.696±0.1	1.554±0.1	1.160±0.05	1.191±0.04
	4 * 25	2.396±0.10	2.513±0.5	2.107±0.2	1.369±0.08	1.369±0.05
	4 * 50	2.902±0.34	2.905±0.3	2.288±0.1	1.527±0.09	1.483±0.1
	4 * 75	2.696±1.13	2.953±0.7	2.365±0.4	1.805±0.22	1.697±0.2
	P =	**0.0076**	**0.039**	**0.0616**	**0.0005**	**0.0005**

Note: [1] Means that are not carrying the same superscripts are significantly different, $P<0.05$.

Figure 1: Body Weight Gain of the Broilers as Affected by the Interaction Between Sprouting Time (2 Days) and Level of Replacement During the Weeks of the Experiment

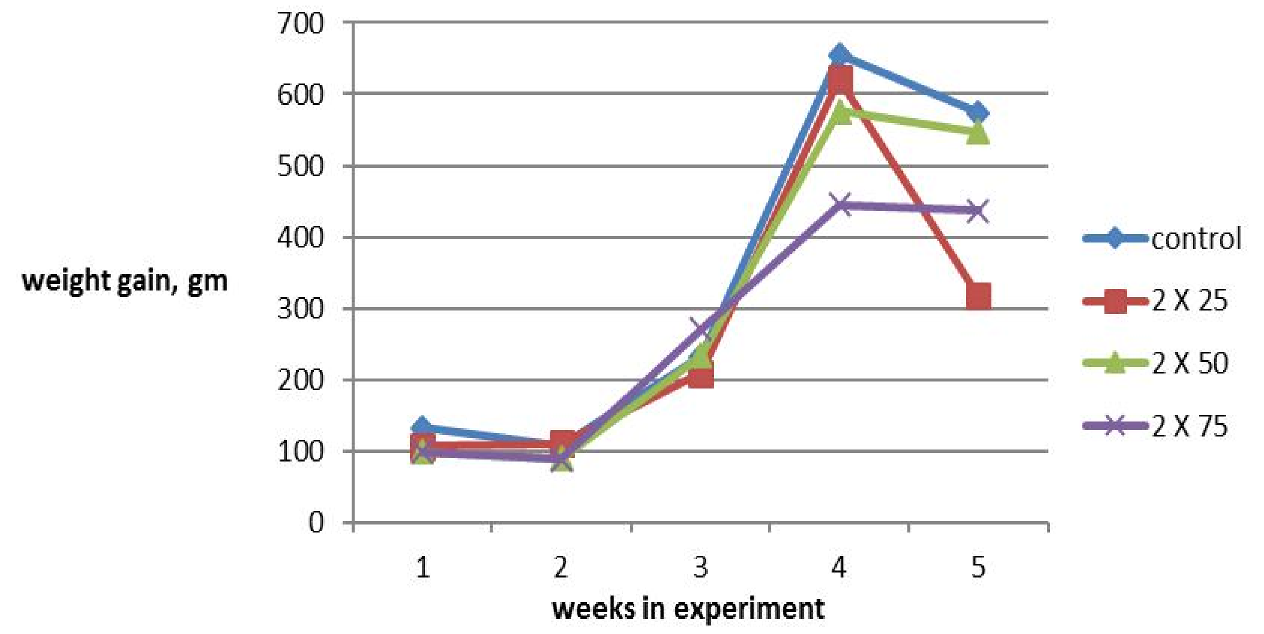
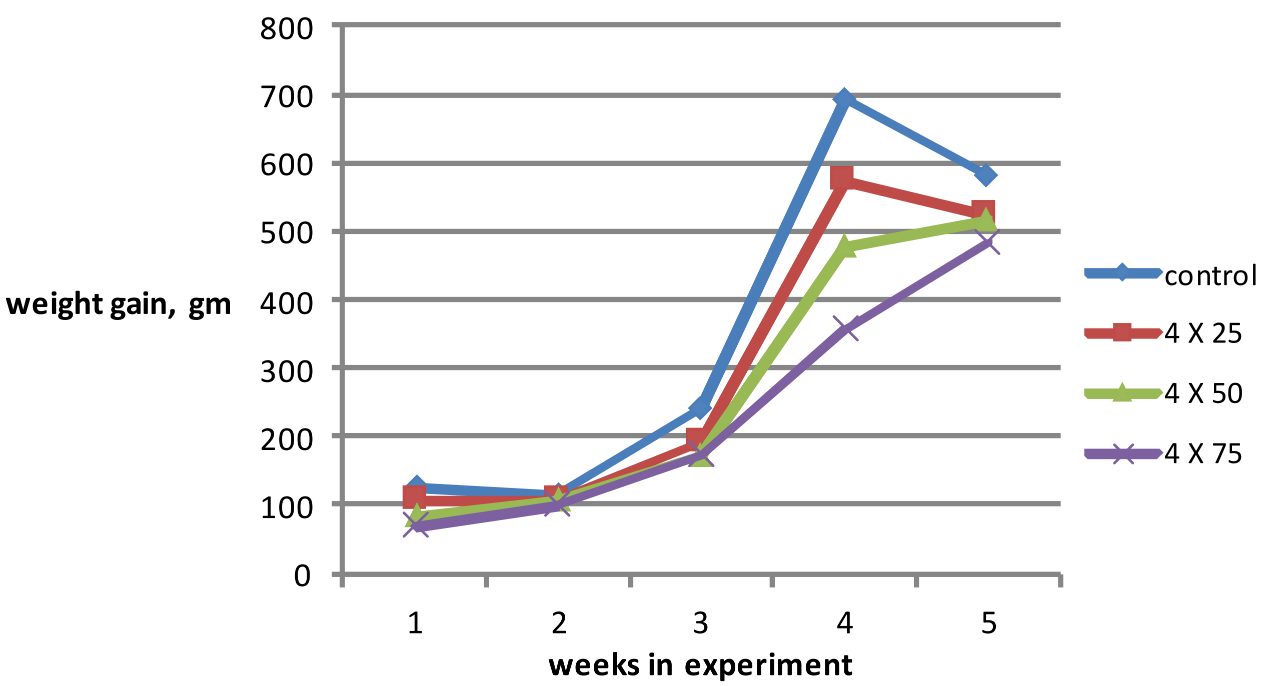


Figure 2: Body Weight Gain of the Broilers as Affected by the Interaction Between Sprouting Time (4 Days) and Level of Replacement During the Weeks of the Experiment



broilers. No significant differences were found on levels of replacements or germination time or the interaction between both and sex of the bird (Table 8).

Table 7: Effect of Replacing Yellow Corn with Germinated Barely on Viscosity of the Digested Intestinal Fluids

Treatments	Digested Intestinal Liquid
Period of Germination	
2 days	0,53[a]
4 days	0.57[a]
P =	**0.1862**
Level of Replacement	
0%	0.61[a]
25%	0.55[a]
50%	0.54[a]
75%	0.51[a]
P =	**0.1908**

Note: Column with similar superscript refers to 'Not significant' at 5% probability. 2 days of germination, 4 days of germination.

Table 8: The Effect of Sex of the Birds, Sprouting Time and Level of Replacing Corn with Sprouted Barely on Dressing Parameters[1]

Source of Variation	Traits		
Replacement, %	**Dressing %**	**Giblets %**	**Giblets %**
0	79.06[a]	6.437b	5.085b
25	77.62[ab]	7.134a	5.538a
50	78.54[ab]	7.002a	5.485a
75	76.69[b]	7.330a	5.611a
P =	**0.0609**	**0.0115**	**0.0383**
Sex	NS	NS	NS
Male	77.76a	6.892a	5.353a
Female	78.20a	7.059a	5.506a
P =	**0.5072**	**0.3874**	**0.265**
Germination Time	NS	NS	NS
2-Days	78.06a	6.808a	5.303a
4-Days	77.90a	7.143a	5.556a
P =	**0.8013**	**0.0853**	**0.0687**

Table 8 (Cont.)

Interaction	NS	NS	NS
4 x F	77.92±2.52	7.326±1.04	5.698±0.74
4 x M	77.88±2.70	6.959±0.81	5.414±0.58
2 x F	78.48±2.87	6.791±0.70	5.315±0.42
2 x M	77.65±2.57	6.825±0.70	5.292±0.49
P =	**0.5427**	**0.2977**	**0.3432**
0 x F	79.554±2.47	6.560±0.55	5.212±0.36
0 x M	78.562±2.47	6.314±0.38	4.958±0.29
25 x F	77.058±2.90	7.416±0.78	5.721±0.72
25 x M	78.188±2.71	6.851±0.74	5.354±0.57
50 x F	79.228±2.52	6.786±1.15	5.354±0.73
50 x M	77.864±1.58	7.218±0.59	5.616±0.41
75 x F	76.94±2.06	7.472±0.87	5.738±0.55
75 x M	76.441±3.30	7.188±0.90	5.485±0.64
P =	**0.5425**	**0.3084**	**0.3664**

Note: [1] Means within each column carrying different superscript are significantly ($P<0.05$) different 0, 25, 50 75% replace corn in the diets. 2-das, 4-days = 2 and 4 days of sprouting.

CONCLUSION

Data from this study provided evidences that despite the overwhelming of the control (only corn) in body weight and weight gain, with exclusion of 75% replacement, I feel the differences were not so great between the control and the combination of 25% and 2 day replacement and 50% and 2 day replacement in Week 5, having in mind the benefits of adding sprouted barely. It is concluded that despite the high fiber, especially in 4 days germination, sprouted barely may be added to the poultry diets but with caution.

ACKNOWLEDGMENT

The authors are grateful to the Deanship of Scientific Research of King Faisal University for their generous financial support during the experimental Period.

REFERENCES

1. Afsharmanesh M, Paghaleh A S and Kheirandish R (2013), "Effects of Sprouted and Nonsprouted Wheat and Barley with and Without Enzyme on Intestinal Morphometry of Broiler Chickens", *Comparative Clinical Pathology*, Vol. 22, pp. 993-998.

2. Annison G and Choct M (1991), "Anti-Nutritive Activities of Cereal Non-Starch Polysaccharides in Broiler Diets and Strategies Minimizing their Effects", *World's Poult. Sci. J.*, Vol. 47, pp. 232-242.

3. AOAC (2000), *Official Methods of Analysis*, 17th Edition, AOAC Int., Gaithersburg, MD.

4. Bull R C and Peterson C F (1969), "Nutritive Value of Sprouted Wheat for Swine and Poultry", *J. Anim. Sci.*, Vol. 28, p. 856.

5. Chavan J and Kadam S S (1989), "Nutritional Improvement of Cereals by Sprouting", *Critical Reviews in Food Science and Nutrition*, Vol. 28, No. 5, pp. 401-437.

6. Chung T, Nwokolo E N and Sim J S (1989), "Compositional and Digestibility Changes in Sprouted Barely", *Plant Foods Hum Nutr.*, Vol. 39, No. 3, pp. 267-278.

7. Duncan D B (1955), "Multiple Range and F-Tests", *Biometrics*, Vol. 11, pp. 1-42.

8. Falen L F and Peterson C F (1969), "Comparison of Sprouted versus Normal Wheat When Fed to White Leghorn Cockerel Chicks", *Poult. Sci.*, Vol. 45, pp. 1772-1775.

9. Farlin S D, Dahmen J J and Bell T D (1971), "Effect of Sprouting on Nutritional Value of Wheat in Cattle Diets", *Can. J. Anim. Sci.*, Vol. 51, pp. 147-151.

10. Fazaeli H, Golmohammadi H A, Tabatabayee S N and Asghari-Tabrizi M (2012), "Productivity and Nutritive Value of Barley Green Fodder Yield in Hydroponic System", *World Applied Sciences Journal,* Vol. 16, No. 4, pp. 531-539.

11. Fuente J M P, Perez de Ayala A Flores and Villamide M J (1998), "Effect of Storage Time and Dietary Enzyme on the Metabolizable Energy and Digesta Viscosity of Barely-Based Diets for Poultry", *Poult. Sci.*, Vol. 77, pp. 90-97.

12. Lorenz K (1980), "Cereal Sprouts: Composition, Nutritive Value, Food Applications", *Crit. Rev. Food Sci. Nutr.*, Vol. 13, No. 4, pp. 353-385.

13. Moghaddam A S, Mehdipour M and Dastar B (2009), "The Determining of Digestible Energy and Digestibility Coefficients of Protein, Calcium and Phosphorus of Malt (Germinated Barley) in Broilers", *International Journal of Poultry Science,* Vol. 8, No. 8, pp. 788-791.

14. National Research Council (NRC) (1994), *Nutrient Requirements of Poultry*, 9th Edition, Academy Press, Washington DC.

15. Peer D J and Leeson S (1985a), "Feeding Value of Hydroponically Sprouted Barley for Poultry and Pigs", *Animal Feed Science and Technology,* Vol. 13, pp. 183-190.

16. Peer D J and Leeson S (1985b), "Nutrient Content of Hydroponically Sprouted Barley", *Anim. Feed. Sci. Technol.*, Vol. 13, pp. 191-202.

17. Rowland L O J, Plyler J E and Bradley J W (1978), "The Feeding Value of Weather Damaged Grain Sorghum for Poultry", *Poult. Sci.*, Vol. 57, No. 1, pp. 180-185.

18. SAS Institute (2008), *SAS/STAT® SAS User's Guide*, Ver 6, 4th Edition, Vol. 1, SAS Inst. Inc., Cary, NC.
19. Sibbald I R (1976), "A Bioassay for True Metabolism Energy in Feedingstuffs", *Poult. Sci.*, Vol. 55, pp. 303-308.
20. Sibbald I R, Slinger S J and Pepper W F (1962), "Sprouted, Frozen and Moldy Wheats as Sources of Nutrients for Chicks", *Poult. Sci.*, Vol. 41, No. 1, pp. 1003-1004.
21. Steel R G D and Torrie J H (1980), "Principles and Procedures of Statistics", McGraw Hill, New York.
22. Svihus B C, Newman W, Newman R K and Selmer-Olsen I (1997b), "Changes in Extract Viscosity, Amino Acid Content, and Soluble and Insoluble β-Glucan and Dietary Fibre Content of Barley During Different High Moisture Storage Conditions", *Anim. Feed Sci. Technol.*, Vol. 64, pp. 257-272.

International Journal of Agricultural Sciences and Veterinary Medicine
Hyderabad, INDIA. Ph: +91-09441351700, 09059645577
E-mail: editorijasvm@gmail.com or editor@ijasvm.com
Website: www.ijasvm.com

ISSN 2320-3730