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Nutritive Value, Metabolizable Energy and Viscosity of Kitchen-waste on Broiler Chicken Performance

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Abstract: Kitchen-waste could be used in poultry feeding. One hundred and eighty Arian day old chickens were placed in 4 treatments, includes 4 replicates and 23 chickens in each. Treatments were consisted in (0, 10, 20 and 30%) kitchen-waste which was used after processed. Gross and metabolizable energy in kitchen-waste were 4300 and 1999 kcal kg^{-1}, respectively. No significant differences were observed in body weight, weight gain and feed conversion ratio in 42 days of age. In contrast feed intake was significantly ($p<0.05$) higher in 10% of kitchen waste compared to other treatments. Brest meat was significantly greater ($p<0.05$) in kitchen-waste diets than control. The similar trend was shown in intestinal viscosity. The result of this study has shown that kitchen-waste could be used 10% in broiler feeding without any adversely effect.

Key words: Arian chicken, kitchen-waste, processing

INTRODUCTION

Much more attention has been made to find out the new source of feed in poultry nutrition. Kitchen-waste is one of the by-products not only could decline the feeding cost but also may reduce cereal grain consumption in chicken nutrition which is competitor by human nutrition. Kitchen-waste quality may be influenced by various factors such as geographical location, season, human foods, collection methods, processing and also their chemical composition (Boda, 1990). Chemical composition of kitchen-waste could be differences from different places and variety sources. In point of this view general and average nutrient of this by-product consist on 31.6 Dry Matter (DM); 92.1 Organic Matter (OM); 7.9, Ash; 17.5 Crude Protein (CP); 20.1, Ether Extract (EE); 3.6 Crude Fiber (CF); 50.9%, Nitrogen Free Extract (NFE); 87.8 MJ kg^{-1} DM Gross Energy (GE) and 23.9 MJ kg^{-1} DM Digestible Energy (DE) which were reported by (Boda, 1990; FAO, 1993). Nutritive value of kitchen wastes and their digestibility are variable and somewhat related to the source. Higher CP and lower NFE have been found in restaurant-waste which was the similar of kitchen waste, by more sources of meat in this content (Okoye *et al*., 2005; File//A:W5.html, 2003) have indicated that the quality of kitchen-waste was at the low value and it needs to be mixed with supermarket wastes (protein concentration) since they include fish, chicken meat, vegetables and fruit-wastes. It has been suggested that restaurant-waste should be combined by 30% of fish meal and meat meal for getting the desirable results. In two groups fed of food waste plus energy supplements (at 25 or 50%) of intake in the corn/ soybean meal diet) gained faster ($p<0.05$) than pigs fed food waste alone (Westendorf *et al*., 1998). On the other hand, lack of body weight was recognized in 4 weeks of age, in spite of economic beneficial (Karakas *et al*., 2001). In addition environmental decontamination could be obtained by processing and utilization of waste. (Froning and Bergquist, 1990). Based on these conflicting results the aim of this study was to determine chemical content, metabolizable energy and viscosity of kitchen-wastes in Hamadan province on broiler performance in poultry industry.

MATERIALS AND METHODS

This study has been carried out in animal science research centre of Bu-Ali Sina University, in August 2003 in Hamadan-Iran. Kitchen-wastes of Hamada province were collected from 17 centers includes: Hospitals, universities, restaurants, army centers, some administration area. This kitchen-waste was included: residual of rice, beards, cereal, vegetable and types of meats, salts, lemons, oils, bone, potato, tomato, peas and some feed additives. In the first step, these materials were collected and dry in air condition at room temperature and then they dried in 50°C for 20 min. They were mixed with 1 kg ton^{-1} antioxidant for preventing of fat oxidation in this content. In the next step they dried for two weeks in

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Table 1: Feed ingredients and nutrients of experimental diets (%)

Experimental grower diets					
30(%) KW	20(%) KW	10(%) KW	Control	Starter	Ingredients
30.00	20.00	10.00	-	-	KW
50.58	61.55	61.55	62.00	53.00	Corn grain
18.07	20.21	20.21	27.16	31.21	SM
-	-	-	6.58	8.00	Wheat (Soft)
6.29	5.00	3.77	-	3.00	Fish meal
5.00	3.04	1.00	-	1.37	Sunfl. oil
0.84	0.94	1.02	1.40	1.36	DCP
1.21	1.27	1.34	1.41	1.19	$CaCO_3$
-	0.10	0.11	0.31	0.32	Salt
0.25	0.25	0.25	0.25	0.25	Min. S.
0.25	0.25	0.25	0.25	0.25	Vit. S.
0.30	0.30	0.30	0.30	-	L-Lys.
0.20	0.20	0.20	0.20	0.14	DL-Mt.
					Calculated nutrient
2900	2900	2900	2900	2900	Kcal kg^{-1} ME
18.13	18.13	18.13	18.13	20.59	CP
					Measurement nutrient (%)
91.13	90.23	90.63			DM
17.87	18.62	17.77			CP
3.53	3.18	4.04			CF
10.03	7.16	5.05			EE
60.08	62.40	65.89			NFE
8.49	8.64	7.25			Ash

KW, Kitchen-waste; SM, Soybean Meal; Min. S, Mineral Supplementation; Sunfl., Sunflower; Vit. S, Vitamin Supplementation; Mt. Methionine; Lys, Lysine, Mineral supplementation: Magnesium oxid 64 g, Zn oxid 44 g, Iron sulphate 100 g, Copper oxid 16 g, I 0.64 g, vitamin supplementation, Teamine, 1.6 g, Rebofelavine 0.72 g, K3 3.3 g, vitamin E 14.4 g, vitamin D 7 g, vitamin A 7.2 g, pantotnic 12 g, Niacin 12160 Mg; perdoxin 612 g, cobalamine 0.6 g, Biotine 0.2 g, coline clroide 440 mg

room temperature. In the final step they were grinded with hammer mail and collected the samples for analysis in laboratory by (AOAC, 1997) methods. Metabolizable Energy (ME) was determined by Sibbald methods (Sibbald, 2000, 1989) using 16 roosters, after 24 h fasting and 40 g of kitchen-waste which was fed. Their fecal was collected after 48 h and dry in 105°C in oven for 24 h and then Gross Energy (GE) was measured by bomb calorimeter. Two hundred and seventy Arian unsexed day old chickens were used. They were arranged in 4 treatment and 4 replicates with 23 chicken in each. Complete Randomized Design (CRD) was used as statistical procedure. Treatments were modulated in, 0, 10, 20 and 30% of kitchen-waste. These treatments were considered in grower period (Table 1). Pre-starter (in 0-10 days), starter diet were fed (in 10-21 days) and grower period was arranged in 21-42 days of age. All rearing condition such as (temperature, humidity, lightning and vaccination were used as a similar). Chemical analysis of kitchen-waste, Body Weight (BW), Feed Intake (FI), Feed Conversion Ratio (FCR) were measured in 21, 35 and 42 days of age. Different part of carcass yield, breast meat, organs weight and intestinal digesta was collected for determination of viscosity, by using methods of Shocmaker *et al*. (1981). Data was analyzed by SAS program (SAS Institute, 1996) and means were tested by multiple Duncan test. This study was confirmed by Bu-Ali Sina university Animal care committee.

RESULTS

Chemical analysis and ME were measured by AOAC (1997) and (Sibbald, 2000, 1989) methods, respectively which are presented in Table 2. Body Weight (BW) and Body Weight Gain (BWG) were illustrated in Table 3. BW in control treatment (1672.4 g) was significantly lower ($p<0.05$) than other treatments, although no differences were found between other treatments (different levels of kitchen-wastes). The similar trend were observed in BWG during 21-35 days of age between kitchen-waste treatments with lower significant exception in control ($p<0.05$).

No significant differences were indicated in Feed Intake (FI) in 21-35 days of age, in contrast this character was significantly higher ($p<0.05$) than other treatment by 10% of kitchen-waste in 35-42 and 21-42 days of age (1755.2 and 3800 g) respectively. Where FCR was higher (2.07) in control group in comparison to other reflection ($p<0.05$) in 21-35 days at Table 4. Carcass weight and partial body weight have shown at 45 days of age in the Table 5. Breast meat in 20% kitchen-waste (535 g) and relative percentage in this treatment (20.385 g) were significantly higher ($p<0.05$) compared with other treatments. Although relative of neck percentage in 10% of kitchen-waste was significantly greater ($p<0.05$) than 30% of kitchen-waste. Organs weight and also relative organs weight was appeared in Table 6 at 45 days of age.

Table 2: Nutrient component and energy of kitchen-waste

CF	EE	CP	Ash	DM	Nutrient (%)
3.38	10.58	12.70	6.29	92.94	
TMEn	TME	AMEn	AME	GE	K.W kcal^{-1} kg^{-1}
3530	2575	2905	1991	4300	

Means with no common superscript in columns are significantly different (p<0.05). KW, Kitchen-waste. GE, Gross Energy; AME, Appear Metabolizable Energy; AME, nitrogen corrected appear metabolizable energy, TME, True Metabolizable Energy; TMEn, nitrogen corrected true metabolizable energy

Table 3: Body weight and body weight gain (g)

	Body weight			Body weight gain		
Treatments	21	35	42	21-35	35-42	21-42
Control	641.67	1672.40^{b}	2201.90	1030.48^{b}	529.76	1560.24
10% KW	649.15	1778.73^{a}	2333.22	1129.59^{a}	554.49	1684.07
20% KW	627.36	1776.01^{a}	2287.73	1148.64^{a}	511.79	1660.36
30% KW	624.27	1763.32^{a}	2322.42	1139.05^{a}	559.10	1698.15
SEM	24.81	48.13	88.250	52.33	83.36	102.75
p-value	0.6959	0.0507	0.2720	0.05190	0.8398	0.3568

Means with no common superscript in columns are significantly different (p<0.05). KW, Kitchen Waste. SEM, Standard Error of Means

Table 4: Feed intake and Feed Conversation Ratio (FCR)

	FI (g)			FCR		
Treatments	21-35	35-42	21-42	21-35	35-42	21-42
Control	2127.5	1240.7^{b}	3368.3^{b}	2.07^{a}	2.36	2.17
10% K.W.	2044.8	1755.2^{a}	3800.0^{a}	1.81^{b}	3.18	2.26
20% K.W.	2025.0	1344.7^{b}	3369.7^{b}	1.76^{b}	2.80	2.04
30% K.W.	1977.2	1363.8^{b}	3341.0^{b}	1.74^{b}	2.45	1.97
SEM	164.25	159.81	245.48	0.150	0.594	0.196
p-value	0.6959	0.0045	0.0677	0.0583	0.2799	0.2277

Means with no common superscript in column are significantly different (p<0.05); FI, Feed Intake; FCR, Feed Conversion Ratio; K.W, Kitchen Waste; SEM, Standard Error of Means

Table 5: Actual and relative weight of carcass

Treatments	Carcass	Breast	Leg	Quarter	Wing	Neck	Back
Actual carcass weight (g)							
Control	1475.97	430.00^{b}	100.14	203.33	156.66	62.49	523.33
10 % KW	1564.42	470.00^{ab}	95.35	222.50	157.50	71.57	547.50
20% KW	1622.70	535.00^{a}	92.18	217.50	150.00	58.01	570.00
30% KW	1658.67	500.00^{ab}	106.23	222.50	170.00	59.94	600.00
SEM	140.65	59.34	14.50	20.97	14.16	10.25	52.80
p-value	0.2313	0.0823	0.5560	0.4300	0.2840	0.2921	0.266
Relative carcass weight (% LW)							
Control	59.91	17.45^{b}	4.05	8.27	6.39	2.52^{ab}	21.22
10% KW	60.04	18.03^{b}	3.65	8.51	6.09	2.73^{a}	21.01
20% KW	62.10	20.38^{a}	3.51	8.37	5.79	2.24^{ab}	21.80
30% KW	60.83	18.39^{ab}	3.89	8.15	6.22	2.19^{b}	21.97
SEM	2.39	1.52	0.41	0.21	0.75	0.33	1.09
p-value	0.5295	0.0612	0.2193	0.8792	0.6643	0.1174	0.5409

Means with no common superscript in column are significantly different (p<0.05); KW, Kitchen Waste. SEM, Standard Error of Means; LW, Live Weight

Table 6: Actual and relative weight of supply organs

Treatments	PV	Gizzard	SI	Pancreas	Liver	Heart	ABF
Actual supply organs weight (g)							
Control	8.29	44.56	77.95	5.27	54.55^{b}	12.71	47.02
10% KW	8.19	40.71	67.18	5.46	59.17^{ab}	14.56	56.77
20% KW	7.66	41.10	71.37	5.30	55.24^{b}	13.51	56.27
30% KW	8.51	43.21	66.53	4.68	65.17^{a}	15.24	60.05
SEM	0.93	4.98	1.92	0.5353	6.27	2.18	15.68
p-value	0.6119	0.6006	0.2947	0.2270	0.0712	0.3299	0.5878
Relative supply organs weight (% LW)							
Control	0.336	1.812	2.951 ^{a}	0.214^{a}	2.210	0.512	1.925
10% KW	0.315	1.565	2.579 ^{ab}	0.211^{a}	2.273	0.561	2.202
20% KW	0.297	1.577	2.741 ^{ab}	0.204^{ab}	2.138	0.522	2.155
30% KW	0.311	1.587	2.446 ^{b}	0.171^{b}	2.140	0.556	2.203
SEM	0.034	0.178	0.267	0.024	0.233	0.075	0.633
p-value	0.4182	0.1178	0.1354	0.0800	0.4179	0.6953	0.8715

Means with no common superscript in columns are significantly different (p<0.05). PV, Proventicular; SI, Small Intestine; A. BF, Abdominal Fat; KW, Kitchen Waste; SEM, Standard Error of Means; LW, Live Weight

Table 7: Viscosity in end of rearing period (centipoises)

Treatments	Viscosity in 42 days
Control	1.124[b]
10% KW	1.253[a]
20% KW	1.322[a]
30% KW	1.286[a]
SEM	0.066
p-value	0.0136

Means with no common superscript in columns are significantly different ($p<0.05$); KW, Kitchen Waste; SEM, Standard Error of Means

Liver weight in 30% of kitchen waste (65.17 g) was significantly higher ($p<0.05$) compared with control and 20% of kitchen-waste. Percentage of empty intestinal weight in 30% of kitchen waste (2.44%) was significantly lower than control diet, in contrast pancreas percentage weight in this respect (0.171%) was significantly lower than control and 10% of kitchen waste ($p<0.05$). Lower significant viscosity (1.124 cips) has shown by control treatment than other levels of kitchen-waste ($p<0.05$) (Table 7).

DISCUSSION

Dry matter of kitchen waste after processing was the similar to cereals such as wheat, barley and rye (92.94%) NRC (1994). Kitchen-waste crude protein was elucidated (12.7%) which corresponding with wheat and barley (10.2 and 11.6%), respectively. These findings were supported by NRC (1994). Fiber as limitation agent in chickens nutrition was not very high in kitchen-waste (3.38%) this was in a similar range of cereal and didn't show any adversely effect in chicken performance. In contrast huge differences were found in fat content of kitchen-waste (10.58%) in comparison to wheat, barley and corn (1.9, 1.8 and 3.8%), respectively (FAO, 1993; NRC, 1994). Therefore it needs to be protected by anti-oxidant supplementation with this specially condition. A high level of ash (6.29) in kitchen-waste was also the next limitation factor which related to high content of bone in this by-product which was agreed by File//A: W5.htm (2003).

In the current study Gross Energy (GE) of kitchen-waste was 4300 kcal kg^{-1} this was more than wheat and barley GE, 4160 and 3930 kcal kg^{-1}, respectively (NRC, 1994). It could be related to high level of fat in kitchen-waste In terms of AMEn kitchen-waste was in cereal range 2905 kcal kg^{-1}, although wheat, barley, rye and corn were (3120, 2640, 2625 and 3350 Kcal kg^{-1}), respectively. In contrast of high level of fat in kitchen-waste (10.58%), no response was observer in regarding to increasing metabolizable energy in this respect. This may be concern to types of fat content in this source of feed. Since heavy and saturated fat may not digestible well and could not be consume and absorb by chicken, this was approached by Fuller (1994).

Body weight by kitchen-waste feeding was higher at 35 days of age than other treatments. this may be due to the high levels of fat in kitchen-waste. Following of this trend no differences were elucidated in body weight at 42 days of age. Since broiler could be able to compensated their weight in short period, these points were noted by Cabel and Waldroup (1991) and Zubair and Leeson (1996). Body weight was declined by kitchen-waste feeding in broiler during four weeks of age (Westendorf *et al*., 1998). The similar reflection was seen in body weight gain since the body weight gain was lower than standard ration in 21-35 days of age, this could be compensated in the 35-41 days of age.

Feed intake was increased in low level of kitchen-waste compared with control groups, but in high level of kitchen-waste no significant response was found, this was pointed out by Westendorf *et al*. (1998). Although feed intake could be influenced by physical satiety (Holsheimer and Ruesink, 1993; Hussein *et al*., 1996; Saki *et al*., 2005) but more consideration and attention should have made to feed selection action by broiler and this could be effected by genetic potential and growth rate (Gous, 1998), consequently this point demonstrated that the similar reaction was observed between feed intake in all treatments except 10% of kitchen-waste. Feed Conversion Ratio (FCR) was improved by kitchen-waste rations than control diet in starter and grower period this may be related to more increasing body weight by this treatments.

Breast meat was induced by kitchen waste but no response was found in the other part of body weight in this respect. Much studies was not carried out in these aspects of study for comparison.

Gastrointestinal development corresponding by increasing nutrient digestibility and absorption which was shown by Kadim *et al*. (2002). Relative of intestine weight was significantly lower by kitchen waste. This might be due to low level of kitchen-waste fiber compared with control and other diets. Reduction of pancreas weight in feeding waste may be coupled with low fiber content in this ration. Dunnington and Siegel (1995) and Shi-Hou *et al*. (1998) have noted that organs weight particularly gastrointestinal tract weight may be induced by high level of fiber in diet. Iji *et al*. (2001) have shown that intestinal volume and weight could be increased by high viscosity diet (cereal diet). All waste treatments were significantly higher ($p<0.05$) in the viscosity than control group. This situation may be related to some cereal in kitchen-waste. This particular case was supported by Leeson and Summers (2001).

Based on these findings of study the kitchen-waste could be used in 10% in broiler rations without any adversely effect. Since this by-product is so cheap, available and its processing is also too easy for poultry industry. It need to be further investigation for different strain of birds as well as by differ methods of processing and location of kitchen waste sources.

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