

*Original Research***Effects of Dietary Inclusion of Dehydrated Swill for the Growth Performances of Male Layers****AGKMPMN Bandara, WAD Nayananjalie* and AMJB Adikari**

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Abstract

The study was conducted to evaluate the effect of dehydrated swill (DS) inclusion in the diet of male layers on growth performances. Experimental diets were prepared by incorporating DS at different levels with commercial broiler ration. Day old, 200 male layer chicks were randomly assigned into five treatments; T1 (0% DS, control), T2 (10% DS), T3 (20% DS), T4 (10% DS + adjusted crude protein) and T5 (20% DS+ adjusted crude protein) in Completely Randomized Design with four replicates of ten birds per each. On day 90, feed intake, feed conversion ratio and dressing percentage of birds fed with different diets were not significantly different among treatments. However, birds fed with T5 showed significantly lower body weight and carcass weight compared to the control. Dehydrated swill can be incorporated in to broiler rations up to the level of 20% without interfering on growth performances of male layers.

Key words: Dehydrated Swill, Dressing Percentage, Feed Intake, Male Layer

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Introduction

Poultry is the most developed livestock sub sector in Sri Lanka. It has shown a high growth rate over the past few years (DCS, 2014). Further, up to 70% of Sri Lanka's chicken and eggs come from small scale farms. The demand for chicken meat and eggs has been fulfilled by local production (Alahakoon *et al.*, 2016). However, small-scale farmers are facing several difficulties due to the high cost of birds and feed ingredients. Both broiler chicks and male layer chicks can be raised for meat. The cost for broiler chicks is comparatively higher. Day old layer chicks are produced by 11 layer breeder farms in Sri Lanka (DAPH, 2016). In most of the hatcheries, millions of day old male layer chicks are killed every day since they are not commercially profitable to rear for meat purpose. However, in recent years, the majority of day old

male layer chicks are raised for meat production and only a small number is used in feed industry. After sexing of day-old chicks in the hatchery, healthy male layer chicks are identified and sold at very low price. Then, these male chicks are raised like broilers for meat production. Hence, this is a way to reduce the cost of production in poultry meat industry (Soisontes, 2016).

Broiler chickens are normally marketed at around 40 days of age and the simplest way of feeding broilers is to purchase complete rations from feed stores. Broiler starter and finisher can be used for male layers, which are high in protein and energy. However, male layers has to be fed for 60 days to reach a weight of 0.8 - 1.2 kg (Soisontes, 2016) and they require less protein and energy due to their slower growth rate (Salami *et al.*, 2002). They cannot be fed with layer feeds because it does not give a rapid growth and its feed conversion efficiency is less. However, many stores do not handle special feeds prepared for male layers. In order to minimize the cost of feed, low cost and locally available substitutes can be used to produce feeds. Nowadays, attention has been paid on frequently available low cost materials for feed formulation with increasing environmental concerns. Waste food is one of the solutions that has been suggested as a remedy to overcome above problems. Food waste (swill) accumulated at the stage of production, processing, retailing and consumption, is discarded or uneaten. The use of food waste in livestock feeding helps farmers to reduce feed costs while reducing the food waste disposal costs and minimizing the environmental impacts of this waste.

Therefore, present study was carried out to promote the extensive use of dehydrated food waste (DFW) as a potential feedstuff on meat production in male layers while investigating the effects of dietary inclusion of DFW on growth performance, carcass traits and serum lipid profile.

Materials and Methods

Experimental Location

Experiment was conducted at the Livestock Farm, Faculty of Agriculture, Rajarata University of Sri Lanka, Puliyankulama, Anuradhapura, Sri Lanka.

Animals and Experimental Design

Day old, 200 male layer chicks (Shaver brown 579) were randomly assigned into five treatments; T1 (0% dehydrated swill (DS) or control, T2 (10% DS), T3 (20% DS), T4 (10% DS + adjusted crude protein) and T5 (20% DS + adjusted crude protein) in Completely Randomized Design (CRD) with four replicates of ten birds per each. Crude protein content in T4 and T5 was adjusted as per the recommendation by incorporating fish meal.

Feed Preparation and Feeding

Swill was collected from the student center and the hostel cafeterias of Faculty of Agriculture, Rajarata University of Sri Lanka. Inorganic wastes were removed manually and then swill was laid on the net trays. Water was removed via filter bed and natural air drying was done before keeping the swill in the dryer. The swill was dried at 80°C for 4 – 6 hrs in a dryer. Then, dehydrated swill was ground using a grinder and mixed with commercial feeds. Experimental diets were mixed for two phases; starter (0 - 30 days of age) and finisher (31 – 90 days of age). Feed and water were provided *ad libitum* throughout the experiment.

Other Management Practices

Day old chicks were introduced to pre-heated brooder pen and brooded up to 14 days. Electrical bulbs (100W) were used as heat source and paddy husk was used as litter materials. Chicks were introduced on the paper layer. Just after chicks were introduced to the pens, glucose and vitamins were supplied with drinking water and vitamin supplement was continued with drinking water up to 14 days.

Analysis of Feed Samples

Feed samples were collected randomly after mixing of feeds. Those samples were dried and ground in to fine powder, stored in labeled plastic bottles until analysis. These samples were analyzed to determine the moisture, crude protein, crude fiber, fat and ash according to the Association of Official Analytical Chemist protocols (AOAC, 2005).

Slaughtering of Birds

Birds were starved for 12 hrs and slaughtered at 90 days of age. Five birds were randomly selected from each replicate and weighed. Birds were sacrificed by dislocating the neck and hung until bleeding was completed. During bleeding, blood samples were collected to sample tubes. Heart, gizzard and liver were separated from the carcass and they were. Meat samples were obtained from the breast area for proximate analysis and to determine the fatty acid composition.

Analysis of Blood Samples

Blood plasma was separated from the serum to analyze cholesterol after the centrifugation at 1500 rpm for 20 min. (Labnet Int. - C0060-240V, USA). Three serum samples from each replicate were tested for total cholesterol, high density lipoproteins (HDL), triglycerides (TAG) and low density lipoproteins (LDL) as per the manufacturers guidelines (BIOLABO, France) using a spectrophotometer (LABOMED, USA).

Analysis of Meat Samples

Dry matter, crude fat, crude protein, total ash, crude fiber contents in meat were analyzed according to the Association of Official Analytical Chemist methods (AOAC, 2005). Fat was extracted from the breast

muscle samples following the method described by AOAC (2005) and methylated and fatty acid composition were analyzed with a gas chromatograph (GC-14A, Shimadzu, Japan) equipped with a flame ionization detector according to the ISO12966 (2015) at Industrial Technology institute, Colombo, Sri Lanka.

Data Collection and Analysis

Initial weights of day old chicks were recorded before introducing to the pens. Weight of the given feed and remained feed was measured daily. Body weight was recorded weekly using five birds from each replicate. Birds and each carcass were weighed at slaughtering. Weight gain, feed conversion ratio (FCR) and dressing percentage were calculated. The cost of different diets was (Rs./kg) noted. Feed intake per bird was multiplied by the feed cost to obtain the cost of feed consumed by a bird for the study period. Data were analyzed using the one way Analysis of Variance (ANOVA) procedure of Statistical Analysis Software var. 9.0 (SAS, 2002) to evaluate the treatments. Mean separation was done by Tukey's Studentized Range Test (TSRT) and statistical significance was declared at $p < 0.05$.

Result and Discussion

Growth Performance

Body weight of the birds slaughtered at 90 days of age showed a significantly difference among the treatments ($P < 0.05$) (Table 1). Birds fed with T5 compared to other treatments achieved the lowest body weight. However, there was no significant difference ($P > 0.05$) among body weights of the birds fed with T2 and T3 compared to the control. Birds in this study have gained their body weight with the time and when they were slaughtered at day 90, they have achieved a marketable weight. This was an indication that the diets had sufficient nutrient composition to sustain growth of male layers. Lichovníková *et al.* (2009) showed that, when male layers were reared in free range condition, they achieved 1769 ± 16 g body weight which was higher than the body weights in this experiment. The body weight difference observed in the present study could be due to the variations in genotypes and management conditions. When commercial broiler strains were reared under same conditions and slaughtered on day 42, the body weights reached to 2000 - 2950 g (Attanayaka *et al.*, 2016; Jayathilaka *et al.*, 2017; Pushpakumara *et al.*, 2017). Therefore, when rearing male layers, it was observed that their growth rate was not as fast as broiler strains.

Feed intake and FCR of birds fed with different treatments were not significantly different ($p > 0.05$) among the treatments. Samanthi *et al.* (2015), Attanayaka *et al.* (2016), Jayathilaka *et al.* (2017) and Pushpakumara *et al.* (2017) observed the feed intake of commercial broilers reared under same farm conditions was around 4000 g and this value was doubled compared to feed intake of male layers though they were reared until 90 days.

Table 1: Effect of feeding dehydrated swill on growth performance and carcass weight of male layer birds at day 90

Parameter	Treatments				
	T1	T2	T3	T4	T5
Growth Performances					
BW, g	1618 ± 5 ^a	1615 ± 2 ^a	1591 ± 3 ^{ab}	1549 ± 7 ^b	1484 ± 6 ^c
FI, g	2201 ± 22	2170 ± 19	2124 ± 23	2197 ± 22	1972 ± 18
FCR	3.9 ± 0.2	3.4 ± 0.1	3.6 ± 0.1	4.1 ± 0.1	3.9 ± 0.1
Carcass Characteristics					
CW, g	1129 ± 30 ^a	1052 ± 33 ^{ab}	1054 ± 20 ^{ab}	1016 ± 20 ^{ab}	933 ± 39 ^b
DP, %	69.8 ± 1.7	65.1 ± 2.0	66.3 ± 1.3	65.6 ± 1.5	62.9 ± 2.8
Relative Organ Weights (g per 100 g of body weight)					
Heart	0.85 ± 0.008	0.93 ± 0.008	0.92 ± 0.007	0.90 ± 0.008	0.86 ± 0.007
Gizzard	4.6 ± 0.04	4.6 ± 0.05	4.5 ± 0.05	4.2 ± 0.04	4.5 ± 0.06
Liver	3.5 ± 0.06	3.4 ± 0.05	3.2 ± 0.04	3.9 ± 0.04	4.1 ± 0.05
Meat Composition (%)					
DM	33.2 ± 0.2 ^a	30.6 ± 0.4 ^b	30.9 ± 0.2 ^b	29.1 ± 0.1 ^c	32.1 ± 0.1 ^{ab}
CP	8.3 ± 0.01 ^a	7.7 ± 0.03 ^b	7.3 ± 0.01 ^c	8.3 ± 0.01 ^a	8.1 ± 0.02 ^a
Fat	2.4 ± 0.01 ^a	2.1 ± 0.04 ^b	1.9 ± 0.01 ^c	2.1 ± 0.02 ^b	2.1 ± 0.03 ^b
Ash	2.1 ± 0.01 ^{ab}	2.1 ± 0.05 ^{ab}	1.9 ± 0.01 ^b	2.1 ± 0.01 ^{ab}	2.3 ± 0.05 ^a
Fiber	2.7 ± 0.02 ^b	2.8 ± 0.02 ^{ab}	2.9 ± 0.03 ^a	2.8 ± 0.01 ^{ab}	2.9 ± 0.02 ^a
Serum Lipid Profile (mg/dL)					
TCH	216 ± 3	232 ± 6	218 ± 2	226 ± 2	224 ± 11
TAG	25 ± 3	29 ± 5	38 ± 5	41 ± 6	18 ± 3
HDL	86 ± 1	79 ± 7	89 ± 10	90 ± 2	93 ± 7
LDL	125 ± 4	146 ± 6	121 ± 9	127 ± 2	128 ± 8

^{a, b, c} Means with different superscripts within the same row are significantly different ($P < 0.05$) BW: Body weight, FI: Feed intake, FCR: Feed conversion ratio, CW: Carcass weight, DP: Dressing percentage, TCH: Total cholesterol, TAG: Triglycerides, HDL: High density lipoprotein, LDL: Low density lipoprotein. Data are presented as means ± SE

However, with slower growth rate and less weight gain obtained at day 90, male layers showed higher feed conversion ratio than commercial broilers. Further, the FCR values observed in this study were in line with the FCR values observed by Chen *et al.* (2007) who studied the performances of Taiwan native chicken feeding dehydrated food waste products.

Carcass Characteristics and Organ Weights

The carcass weight was significantly lower ($P < 0.05$) in birds fed with T5 which contained 20% DS with 20% fish meal compared to the birds fed with control treatment (Table 1). However, there were no significant differences ($P > 0.05$) among carcass weights of birds fed with T2, T3 and T4 compared to the control. Carcass weight of male layers reared in free range was 1120 ± 15 (Lichovniková *et al.*, 2009) which is more or less similar to the data reported in this study. However, Taiwan native chicken fed with dehydrated food waste obtained higher carcass weights (Chen *et al.*, 2007) compared to the male layers in

present study. Further, when commercial broilers were reared for 42 days, the carcass weights were greater (Attanayaka *et al.*, 2016; Jayathilaka *et al.*, 2017) than male layers. Further, dressing percentage of male layers fed with different treatments was not significantly different ($P > 0.05$) among treatments. The dressing percentages observed in male layers were lower compared to commercial broilers (Jayathilaka *et al.*, 2017; Pushpakumara *et al.*, 2017).

Table 1 indicates that the effect of feeding DS on the development of internal organs of male layers. Even at 90 days of growth, it did not show any significant difference ($P > 0.05$) among the treatments on the percent weight of heart, liver and gizzard from the carcass weight of the birds. As the weight of internal organs was not changed, the diets containing DS might not affect the physiological status of chicken. Chen *et al.* (2007) also observed the similar relative weights of liver and heart when Taiwan native chicken fed with different levels of dehydrated food waste products.

Meat Composition

The dry matter, protein, fat, ash and fiber content in meat samples obtained in day 90 were significantly different ($P < 0.05$) among the treatments (Table 1). The lower level of dry matter was observed in birds fed with T2, T3 and T4 compared to the meat samples obtained from birds fed with control treatment. As reported by Lichovniková *et al.* (2009) dry matter content observed in male layers was $26.6 \pm 0.06\%$ which is slightly lower compared to the values reported by the present study. Further, Chen *et al.* (2007) reported more or less similar values in Taiwan native chickens fed with dehydrated food waste. Significantly higher ($P < 0.05$) CP contents were observed in the meat samples obtained from birds fed with T1, T4 and T5 compared to T2 and T3. Compared to the control, crude fat content in the meat samples obtained from the birds fed with diets incorporated with DS was significantly lower ($P < 0.05$). Further, the significantly lower fat content was recorded in birds fed with T3 in which birds received 20% of DS. Moreover, Chen *et al.* (2007) and Lichovniková *et al.* (2009) reported lower protein and fat contents in the meat samples of the studied birds and the differences may be incurred due to genotype. The highest total ash content was reported in the meat samples obtained from birds fed with T5 and it was significantly higher ($P < 0.05$) compared to the T3. The higher crude fiber content was reported in meat the samples obtained from birds fed with T3 and T5 compared to the birds fed with control treatment.

The breast meat fatty acid profile of birds reared under different treatments is shown in Table 2. The total level of SFA content was not different in breast meat however; lowest SFA was reported in T3. The highest values for both MUFA to SFA and PUFA to SFA in breast meat were also observed in T3. The lowest n-6 to n-3 (28.63) ratio was reported in T4.

Table 2: Effect of feeding dehydrated swill on breast meat fatty acid profile of male layers

Fatty Acid (g/100 g of fat)		Treatments				
		T1	T2	T3	T4	T5
Lauric acid	C12:0	1.03	1.98	1.3	1.05	1.26
Myristic acid	C14:0	1.46	2.11	1.67	1.58	1.66
Palmitic acid	C16:0	25.22	24.2	24.2	25.57	25.45
Stearic acid	C18:0	8.42	6.85	7.64	7.84	7.37
Arachidic acid	C20:0	0.24	0.24	0.21	0.23	0.24
Total SFA		36.37	35.38	35.02	36.27	35.98
Palmitoleic acid	C16:1 n-7	2.9	3.91	3.3	3.29	4.43
Palmitoleate acid	C16:1 n-9	ND	ND	ND	ND	ND
Vaccenic acid	C18:1 n-7	ND	ND	ND	ND	ND
Oleic acid	C18:1 n-9	39.1	40.44	40.84	38.7	39.63
Paullinic acid	C20:1 n-7	0.07	ND	0.04	ND	0.1
Eicosenoic acid	C20:1 n-9	0.49	0.53	0.53	0.54	0.57
Total MUFA		42.56	44.88	44.71	42.53	44.73
Linoleic acid	C18:2 n-6	18.46	17.15	17.69	18.32	16.96
α -linoleic	C18:3 n-6	0.04	0.03	0.04	0.04	0.04
Eicosadienoic acid	C20:2 n-6	0.22	0.21	0.21	0.26	0.16
DG linolenic acid	C20:3 n-6	0.23	0.17	0.17	0.17	0.18
Arachidonic acid	C20:4 n-6	0.35	0.27	0.28	0.28	0.21
Adrenic acid	C22:4 n-6	0.05	0.07	0.1	0.11	0.08
Docosapentaenoic acid	C22:5 n-6	ND	ND	ND	ND	ND
Total n-6		19.35	17.9	18.46	19.18	17.63
Linolenic acid	C18:3 n-3	ND	ND	ND	ND	ND
Octadecatetraenoic acid	C18:4 n-3	0.51	0.46	0.48	0.55	0.46
Eicosatrienoic acid	C20:3 n-3	ND	ND	ND	ND	ND
Eicosatetraenoic acid	C20:4 n-3	ND	ND	ND	ND	ND
Eicosapentaenoic acid	C20:5 n-3	0.11	0.08	0.05	0.07	0.08
HPA	C21:5 n-3	0.05	ND	0.03	0.05	0.05
Total n-3		0.67	0.54	0.56	0.67	0.59
Total PUFA		20.02	19.11	19.02	19.85	18.22
MUFA/SFA		1.17	1.27	1.28	1.17	1.24
PUFA/SFA		0.55	0.54	0.56	0.55	0.51
n-6/n-3		28.88	33.14	32.94	28.63	25.55

ND = Not detected (Limit of detection = 0.001 g/ 100 g), HPA = Heneicosapentaenoic acid, SFA, saturated fatty acid; MUFA, mono-unsaturated fatty acid; PUFA, poly-unsaturated fatty acid

Feeding management plays a major role in modifying the composition of poultry meat (Bostami *et al.*, 2017) and the body fat deposition is determined dietary fatty acid composition in broilers (Scaife *et al.*, 1994). In addition, poultry meat has low fat which is deliberated as the principal source of polyunsaturated fatty acids (PUFA) with higher concentration of n-3 PUFA. The higher levels of polyunsaturated fatty acids (PUFA) in the meat enhance the consumer demand due to its health aspects. Linoleic and linolenic acid are essential PUFA for humans and hence chicken meat is a good source for these essential fatty acids in human

diet (Boselli *et al.*, 2008; Mitchaonthai *et al.*, 2007). As per the finding of Mandal *et al.* (2014) who concluded that if the ratio of n-6/n-3 FA is lower in poultry meat, it gives the healthy chicken products which is beneficial for consumers.

Blood Serum Parameters

Table 1 indicates that the effect of feeding DS on the blood serum parameters of male layers. The lipid profile including total cholesterol (TCH), HDL, TAG and LDL in serum of birds slaughtered at 90 days of age was not significantly different ($P > 0.05$) among treatments. Table 3 shows the cost-benefit analysis of the experiment. The initial feed cost was different among treatments.

Table 3: Effect of feeding dehydrated swill on total cost, total revenue and profit when rearing male layers up to 90 days

Treatment	Cost / bird (Rs.)	Total Revenue / bird (Rs.)	Profit (Rs.)
T1	376.96	456.42	79.46
T2	342.6	426.74	84.14
T3	310.06	428.49	118.43
T4	338.01	412.77	74.76
T5	292.41	380.71	88.3

1\$ = Rs. 153.00 (Sri Lankan Rupees)

The equal amount of feeds per bird was supplied in all treatments and birds were slaughtered on day 90. The cost for medications and other management practices were also similar among all treatments. The highest total revenue per bird was reported from T1, however the highest profit was reported in T3. When comparing profits of T3 and the control, feeding male layers with 80% commercial feeds plus 20% DS provided a profit of Rs. 38.97 per single bird which is a considerable amount.

Conclusion

Dehydrated swill can be incorporated in to broiler rations up to 20% without interfering on growth performances of male layers. It is economical to slaughter the male layers at 90 days of age when they reach around 1.6 kg of live weight.

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