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Effect of Feeding Different Levels of Dried Tomato Pomace on the Performance of Rhode Island Red Grower Chicks in Wolaita Zone, Southern Ethiopia

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ABSTRACT

This experiment was carried out to evaluate the effect of Dried Tomato Pomace (DTP) in feed intake, body weight gain, Feed Conversion Ratio (FCR) and economic efficiency on Rhode Island Red (RIR) grower chicks. A total of three hundred RIR grower chicks at eight weeks of age were grouped into 20 pens of 15 chicks each and randomly assigned to five treatments (control fed a commercial ration; 5% DTP; 10% DTP; 15% DTP; 20% DTP) according to a completely randomized design(RCD). Birds fed on 5, 10, 15 and 20% DTP had the higher Dry Matter (DM) intake(72.93,72.75, 72.98 and 73.15 g/bird/day) than the control group (72.10 g/bird/day). The daily body weight gain of birds ranged from 13.3-15.3 g/day, the highest being on birds fed on 5% DTP; The Feed Conversion Ratio (FCR) of birds were 5.3, 4.8, 5.0, 5.3 and 5.5 for the control and for birds that consumed 5, 10, 15 and 20% DTP, respectively, with significant difference observed between 5 and 20% DTP. The economic efficiency of the experimental diets was 1.35, 1.79, 1.80, 1.78 and 1.82 for a group fed on the control, 5, 10, 15 and 20% DTP, respectively. There was a higher significant ($p<0.05$) difference on a group fed on DTP and the control diet. DTP which contains 20% brought the highest economic efficiency among the groups. Based on the obtained results it could be concluded that dried tomato pomace could be incorporated in grower chick rations at the level of 20% without any adverse effect on growth performance in order to increase the economic efficiency.

Key words: Dried tomato pomace, feed conversion ratio, dry matter intake, weight gain, economic efficiency

INTRODUCTION

Scarcity of poultry feed is the major problem and the expected output from birds is very low in Ethiopia. To run efficient poultry production in the country regular availability of good quality ingredients and a fully balanced complete feed are very essential. In food insufficient countries, using of alternative feed ingredients in poultry ration is a key determinant of successful poultry production. One such non-conventional feedstuff which could be of value for poultry feeding, is tomato pomace. Tomato pomace is an inexpensive and primary by-product of tomato manufacturing, In Ethiopia there are two tomato processing factories that is Melgi-Wondo and Upper Awash Agro industry. Annually more than 234,902 quintal of tomato can be processed into tomato paste and tomato juice. When tomatoes are processed into products, 10 to 30% of their weight becomes waste or "pomace" (King and Zeidler, 2004). It consists mainly of the skins, seeds and hard tissues of the whole tomatoes. According to King and Zeidler (2004), tomato pomace

contains 5.1% moisture, 11.9% fat, 26.8% protein and 26.3% crude fiber. Moreover, it contains 13% more lysine than soybean protein (Al-Betawi, 2005), a good source of vitamin B, fair source of vitamin A and no known antinutritive factors (Geisman, 1981). It is also fiber rich feed resource and thought to act as a cholesterol reducing feedstuff in poultry products (Al-Betawi, 2005).

However, this huge by product has not yet been extensively utilized as a feed source for poultry. The majority of it is just dumped and allowed to decay in the surrounding areas near the factories (MOA, 2006). So finding solutions to utilize these abundant and inexpensive wastes is very crucial. One of the best alternative means is to utilize this feed stuff as a feed ingredient in poultry ration. Therefore, the possibility of utilizing this waste in feeding Rhode Island Red (RIR) grower chicks is the most promising one to alleviate chronic feed shortages for poultry and reduce cost of feed. The objective of this study intended to evaluate the potential use of Dried Tomato Pomace (DTP) which could be used in poultry feeding on the performance of Rhode Island Red (RIR) grower chicks under intensive management conditions.

MATERIALS AND METHODS

Study Area: The study was carried out in Ethiopia at Wolaita Zone in Soddo town which is found in the Southern Region and located 390 km Southwest of Addis Ababa and 165 km from the town of the region-Awassa. Its total areas is 4383 km^2 (438370 ha). The mean annual temperature of the area is 19°C. The average rainfall is 1014 mm. The livestock population of the area is estimated to be 1.8 million, of which 53% are cattle, 9% sheep and goat, 3% equines and 35% poultry (Biffa *et al*., 2003).

Management of experimental birds: A total of 300 (180 male and 120 female) male and female Rhode Island Red (RIR) grower chicks at eight weeks of age were purchased from Awassa Poultry Multiplication Center. All the birds were randomly divided into 20 pens with 15 (9 male and 6 female) birds/pen. The 20 pens were randomly assigned to five treatment groups. Replicates were housed in the partitioned house with all the necessary facilities for seventy days experimental period. Standard vaccination schedule was done and strict sanitary measures were followed during the experimental period. All birds were vaccinated la-sota vaccine against New Castle Disease for three times at 60, 90,120 days of age. Amprolium was used as a prophylactic treatment for three times (At a time 30 g/100 litters of water for 5 days).

Experimental diet: Wet Tomato Pomace was obtained from Upper Awash tomato processing plant. It was dried by spreading and exposing to sunlight at an open place using plastic sheet as drying material. The particle size of pomace was reduced by beating using stick and hand crushing. Over sized DTP was ground using a hand mortar and passed through 3 mm sieve size. The formulated commercial grower chick ration was bought from Kaliti Animal Feed Processing Factory (KAFPF) and used as a control diet which is presented on Table 1. The chicks were fed in the form of mash for grower diets from the age of eight weeks to eighteen weeks. Feed and water were provided on ad libitum basis. Feed intake and refusals were weighed and recorded every day to estimate the feed consumption for each replicate and treatment. Individual weight of each replicates was taken once per week. Body weight gain was calculated by subtraction of the live body weight at the beginning of the week from that of the second measuring date (BWG, g/d). Feed conversion ratio was calculated as gram feed intake/per gram body weight gain. Feed cost per live weight gain was computed by the cost of feed consumed to attain a kilogram (kg) live weight gain and the economic efficiency was calculated as the ratio between income (price of weight gain) and the cost of feed

Table 1: Ingredients of experimental diets fed to the RIR Grower Chicks

Feed ingredients	T1 (%)	T2 (%)	T3 (%)	T4 (%)	T5 (%)
DTP	0.0	5.0	10.0	15.0	20.0
Corn	30.0	28.5	27.0	25.5	24.0
Wheat bran	10.0	9.5	9.0	8.5	8.0
Wheat middling	27.15	25.65	24.15	22.65	21.15
Nouge cake	15.0	14.25	13.5	12.75	12.0
Soya bean	5.0	4.75	4.5	4.25	4.0
Rape seed	10.0	9.5	9.0	8.5	8.0
Lime stone	2.0	2.0	2.0	2.0	2.0
Salt	0.5	0.5	0.5	0.5	0.5
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.05	0.05	0.05	0.05	0.05
Methionone	0.05	0.05	0.05	0.05	0.05
Total	100.0	100.0	100.0	100.0	100.0
CP (%)	18.66	19.84	21.36	18.82	18.77
ME (kcal kg^{-1} DM)	3157.08	3087.07	3084.95	2789.60	2163.48

consumed (Attia and Ibrahim, 2005). The data were calculated that the price of one kg body weight of bird on selling time and the cost of feeds used according to the prices available in Ethiopian market during the experimental period. By using of the following formula the economic efficiency was calculated (Attia and Ibrahim, 2005):

Price of feed consumption (Birr) = Average feed consumption X price/kg feed

Total revenue (Birr) = Average daily gain (g) X price of one (kg) body weight on selling (Birr)

Net revenue (NR) Birr = Total revenue (Birr)-feed cost (Birr)

$$\text{Economicefficiency(ECE)} = \frac{\text{NR (Birr)}}{\text{Feeding cost of this gain (Birr)}}$$

Laboratory analysis: Representative samples of experimental diets were taken to Debre Zeit National Veterinary Institute for chemical analysis from each of the feed ingredients used in the experiment and analyzed before mixing with the actual dietary treatments. Feed samples were analyzed for Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), Crude Fiber (CF) and ash (AOAC, 2000). The Metabolizable Energy (ME) levels of feed ingredients was calculated using the formula ME (kcal kg^{-1} DM) = 3951+54.4 EE-88.7 CF-40.8 Ash (Wiseman, 1987) presented on Table 2.

Experimental design and statistical analysis: The experiment was arranged in Completely Randomized Design (CRD).The data were analysed to one way ANOVA using SPSS (Version. 13) and SAS (Version 6.12 and GLM procedures) softwares. When treatment effects were found to be significant ($p<0.05$), mean separation was undertaken using Turkey HSD test. All values were calculated on a pen average basis.

RESULTS

The average daily dry matter intake among the treatments that comprised DTP ranged from 72.75 to 73.15 g/bird and as a significantly ($p<0.05$) differed from the control group (72.10 g/bird). The maximum cumulative DM consumption per bird was 5120.50 g in the birds fed on T5

Table 2: Chemical analysis of experimental diets on dry matter basis

			Experimental diets				
Nutrient content	Unit	DTP	T1	T2	T3	T4	T5
DM	%	93.2	90.56	91.42	91.37	91.28	91.36
OM	%	94.00	89.27	90.28	90.75	91.24	92.64
CP	%	21.6	18.66	19.84	20.36	18.82	18.77
ME	kcal kg^{-1} DM	773.3	3157.08	3087.07	3084.95	2789.60	2163.48
CF	%	38.8	8.67	9.26	10.21	13.46	17.00
EE	%	9.5	7.59	6.5	7.26	7.16	7.61
MM	%	6.2	10.73	9.71	8.71	8.75	8.06
NFE	%	24.1	54.35	54.68	52.92	51.80	60.89
Ca	%	0.54	0.64	0.56	0.47	0.64	0.39

DM: Dry matter, OM: Organic matter, CP: Crude protein, ME: Metabolizable energy, CF: Crude fiber, EE: Ether extract, MM: Mineral matter, NFE: Nitrogen free extract and Ca: Calcium

Table 3: Mean dry matter intake of RIR grower chicks

	Experimental Diets						
Parameters	T1	T2	T3	T4	T5	SEM	p-value
Mean daily DM intake (g/bird)	72.10^{b}	72.93^{a}	72.75^{a}	72.98^{a}	73.15^{a}	0.1784	0.000
Mean total DM intake (g/bird)	5046.98^{b}	5102.85^{a}	5092.18^{a}	5108.90^{a}	5120.50^{a}	11.826	0.000

Means with a different superscript in a row are significantly different at $p< 0.05$

(Table 3). The intake was highly improved when birds fed different levels of DTP than those fed on the commercial ration alone.

The mean daily body weight gain of grower chicks during this study was 13.5, 15.3, 14.6, 13.8 and 13.3 g fed on T1, T2, T3, T4 and T5, respectively. The diet containing 5% DTP led to significantly higher body weight gain than those placed on a 20% DTP and the control diet (Table 4). Although statistically not significant from the other treatments, the least mean daily body weight gain was recorded from chicks fed on diets containing 20% DTP.

There was no statistically marked variation in the feed conversion ratio among all treatments compared to the control group. The mean feed conversion ratio was 5.3, 4.8, 5.0, 5.3 and 5.5 for the group fed on T1, T2, T3, T4 and T5, respectively. A group fed with a diet containing 5% dried tomato pomace had significantly higher feed conversion ratio compared with a group that fed a diet containing 20% DTP. Thus, more feed was needed to attain a unit gain compared with a bird fed a diet containing 5% DTP; this may be due to the higher crude fiber content in the experimental diet. The inclusion of 20% DTP was higher fiber content that led to reduced body weight gain.

Feed cost (in Birr) /total gain was 20.16, 19.25 and 18.28, 17.41 and 16.49 Birr for the groups fed on the control diet, 5% DTP, 10% DTP, 15% DTP and 20% DTP, respectively. The inclusion of DTP in growers ration and feed cost per kg feed were inversely proportional. The Economic Efficiency of the experimental diets was 1.35, 1.79, 1.80, 1.78 and 1.82 for a group fed on the control diet, 5% DTP, 10% DTP, 15% DTP and 20% DTP, respectively (Table 5). There was a significant ($p<0.05$) difference between a diet containing 5, 10, 15 and 20% DTP compared with the control (commercial) diet. The highest economic efficiency was obtained at a diet containing 20% DTP.

Table 4: Body weight gain (g/bird) and feed conversion ratio of RIR grower chicks

	Experimental diets						
Parameters	T1	T2	T3	T4	T5	SEM	p-value
Initial b.wt. (g)	485.5	485.2	484.0	486.4	484.3	10.715	0.999
Mean final b. wt. (g)	1433.5^{b}	1559.1^{a}	1508.4^{ab}	1453.05^{ab}	1414.2^{b}	39.284	0.013
Mean daily weight gain (g/bird)	13.5^{b}	15.3^{a}	14.6^{ab}	13.8^{ab}	13.3^{b}	0.561	0.012
Mean total gain (g)	948.3^{b}	1073.9^{a}	1024.4^{ab}	966.7^{ab}	929.9^{b}	39.5	0.014
Feed conversion ratio (FCR)	5.3^{ab}	4.8^{b}	5.0^{ab}	5.3^{ab}	5.5^{a}	0.200	0.016

Means with a different superscript in a row are significantly different at $p< 0.05$

Table 5: Partial budget analysis and economic efficiency of RIR grower chicks fed on DTP

	Experimental diets						
Parameters	Control	5 DTP (%)	10 DTP (%)	15 DTP (%)	20 DTP (%)	SEM	p-value
Cost per chick (Birr/chick)	17	17	17	17	17	00	NS
Feed cost (Birr/kg)	3.62^{a}	3.45^{b}	3.28^{c}	3.16^{d}	2.95^{e}	00	0.000
Feed cost/kg gain	21.32^{a}	18.03^{b}	17.87^{b}	18.03^{b}	17.75^{b}	0.743	0.000
Cost of total feed consumed (Birr/bird	20.16^{a}	19.25^{b}	18.28^{c}	17.41^{d}	16.49^{e}	0.045	0.000
Miscellaneous cost (Birr/chick)	8.9	8.9	8.9	8.9	8.9	000	NS
Total cost (Birr/bird)	46.06^{a}	45.15^{b}	44.18^{c}	43.31^{d}	42.39^{e}	0.045	0.000
Sale (Birr/bird)	50.00	51.00	50.50	50.00	50.00	00	NS
Net profit	3.94^{e}	5.85^{d}	6.32^{c}	6.69^{b}	7.61^{a}	0.045	0.000
Economice efficiency	1.35^{b}	1.79^{a}	1.80^{a}	1.78^{a}	1.82^{a}	0.25	0.002

*Means with a different superscript in a row are significantly different at $p<0.05$, NS: Non significant difference

DISCUSSION

Dried tomato pomace did not affect the DM intake of grower chicks and it improved the mean daily and cumulative feed consumption of birds. Intake improvement might be due to the higher crude fiber or lower Metabolizable Energy (ME) content of DTP. Such fiber increases fecal bulk and speed up the passage of feed through the digestive tract and keeps the health of gastro intestinal tract (Anderson *et al*., 2010). Inclusions of high fiber ingredients are usually limited because of the poor metabolizable energy contents (Johnston *et al*., 2003). To fulfill their energy requirement birds need to consume more feed. If the energy level is low the consumption and FCR are high and vise versa (Say, 1987).

The presence of slightly higher crude protein and less amount of crude fiber in the group fed on the 5% DTP might have contributed to the increase in body weight, as higher amount of protein is broken down in the intestines into its constituent amino acids which may then be absorbed into the blood and used for muscle growth, replacement of body cells and for the synthesis of body tissue (Firman, 1984). The most commonly deficit amino acids in grower chicken ration are lycine, methionine, tryptophane glycine and arginine (Gillespie, 1992). DTP contain these amino acids and could satisfy their amino acid requirements. In addition, they require fats and carbohydrates, vitamins (A, D3, E, K, riboflavin, B12, niacin, panthothenic acid and choline), minerals (Calcium, Phosphorus, Manganese, Iodine, Sodium Chlorine and Zinc) and cannot exist on high fibre diets (Weaver and Plawecki, 1994). In case of the group fed with the diet containing 20% DTP the live body weight and body weight gain was significantly lower than the group fed with 5% DTP due to increased level of crude fiber. In the monogastric animal, fiber represents the insoluble

matter of plant cell walls that is indigestible by animal enzymes, but can be partially degraded by gastrointestinal microflora (Damron and Sloan, 1995). The constituents of fiber affect the gastrointestinal tract differently, ultimately affecting the nutrition of the anima. The crude fiber level not less than 6% and not above 6.5% will be suitable for optimal growth (Chandrasekaran, 2005). The maximum amount of crude fiber, for grower chicks should be 7.0% (Anjum *et al*., 2005). Feed is the principal determinant of the economics of production (Dana and Yami, 2005). The cost of feed ingredients represents 60-80% of the total cost of production for intensively reared poultry in the tropics (Fajimi *et al*., 1993; Tewe, 1997).

Exploitation of agricultural by-products may make a substantial contribution towards better and more economic feeding of poultry. In view of the shortage and the high costs of protein feed stuffs. Tomato pomace could provide part of the protein needed by poultry (Rahmatnejad *et al*., 2009).

The present result clearly indicated that the inclusion of Dried Tomato Pomace at 20% inclusion level in grower commercial ration reduces much production cost, economically feasible and brought high economic efficiency with out affecting feed intake, weight gain, feed conversion efficiency, carcass yield and dressing percentage of grower chicks.

CONCLUSION

Based on the result obtained in this study concluded that the lowest and highest DM intake were observed at the control group and 20% DTP inclusion level, respectively. Birds fed on at 5% DTP inclusion level had the highest body weight gain than the control group. When the level of DTP inclusion in a commercial ration was increased, the body weight gain of birds was reduced. However, by increasing DTP inclusion in the growers ration similar body weight gain was observed that of the control group. Higher Fed Conversion Ratio (FCR) was obtained when DTP was included at 5% level compared with 20% inclusion level. Significantly similar carcass yield and dressing percentage was observed at 20% of DTP inclusion on grower chicks. At 20% DTP inclusion in grower commercial ration significantly reduced the feed cost and increased the economic efficiency for producers compared to the commercial diet.

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