

Full Length Research Paper

The effect of feeding different levels of dried tomato pomace on the performance of Rhode Island Red (RIR) grower chicks

Melkamu Bezabih Yitbarek

Department of Animal Science, Debre Markos University, Ethiopia.

E-mail: melkamu_bezabih@yahoo.com. **Tel:** +251911054673. **Fax:** +251587711764.

Abstract

This experiment was conducted to evaluate the effect of feeding dried tomato pomace (DTP) with commercial ration on the performance of Rhode Island Red (RIR) grower chicks. A total of one hundred RIR grower chicks at eight weeks of age were grouped into 20 pens of 5 chicks each, and randomly assigned to five treatments (control; 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 higher dry matter 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 to 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. 20% DTP brought the highest economic efficiency among the groups. Based on this, 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 (DTP), feed conversion ratio (FCR), dry matter (DM) intake, weight gain, economic efficiency.

INTRODUCTION

The world today is suffering from a serious shortage of livestock feed ingredients because of the rapid increase in human population and feed competition of people and livestock (Adeniji and Oyeleke, 2008). The availability and cost of feed ingredient is one of the major constraints of poultry production. This costs accounts for 60 to 80% of the total cost of production for intensively reared poultry in the tropics (Fajimi et al., 1993; Tewe, 1997). Ethiopia is not self sufficient in cereal grains and could not provide the bulk of concentrate feeds for poultry. There are shortages of protein supplements and micro-nutrients (vitamins and minerals) which are needed for the preparation of balanced rations. Scarcity of poultry feed is the major problem and the expected output from

birds is very low. If food self-sufficiency is to be achieved and malnutrition combated in developing countries particularly in Ethiopia, there is a need to give due attention to poultry production. To run efficient poultry production in the country regular availability of good quality ingredients and a fully balanced complete feed are very essential, because birds require large quantities of energy and sufficient quantities of protein for growth and development. To fulfill these daily nutrient requirements, using alternative feed ingredients in poultry ration is a key determinant of successful poultry production. One of 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. It consists mainly of the skins, seeds and hard tissues of the whole tomatoes. When tomatoes are processed into products, 10 to 30% of their weight becomes waste or “pomace” (King and Zeidler, 2004). 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), and 2130 kcal/kg metabolizable energy (NRC, 1988). It is also fiber rich feed resource and thought to act as a cholesterol reducing feedstuff in poultry products (AL-Betawi, 2005). It is a good feed substitute for the usual ration of growing cattle, growing and fattening pigs, broilers and layers. NRC (1983) reported that it has been successfully fed to cattle, swine and poultry at a 10 to 15 % dietary level, thereby reducing cost of production and increasing profit. However, in the country there are two tomato processing factories (Melgi-Wondo and Upper Awash Agro industry) that produce substantial amounts of tomato pomace. Annually around 23,490,200 kg of tomato can be processed into tomato paste and tomato juice (UAAI, 2009). According to King and Zeidler (2004), 10 to 30% of tomato pomace is produced at time of processing. 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. This is because, in recent years, people are becoming more and more health conscious and prefer meat and egg with low cholesterol content. Efforts are being made to reduce the cholesterol content of egg and meat by feeding poultry with low cost fiber rich diets. There is no documented evidence about the potential of this feed stuff in the country. 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 was intended to evaluate the potential use of dried tomato pomace which could be used in poultry feeding on the performance of Rhode Island Red grower chicks under intensive management condition

MATERIALS AND METHODS

The study area

This 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 km² (438370 ha). The mean annual temperature of the area is 19.0°C. The average rainfall is 1014 mm. It has moderately drained soils (nitosols). 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.

Management of experimental birds

A total of 100 (60 male and 40 female) male and female Rhode Island Red grower chicks at eight weeks of age were purchased from Awassa Poultry Multiplication Center. All the birds were randomly divided into 20 pens with 5 (3 male and 2 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 with la-sota vaccine against new castle disease for three times at 60, 90 and 120 days of age. Amprolium was used as a prophylactic treatment for three times (At a time 30 g /100 L 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 Kality Animal Feed Processing Factory (KAFPF) and used as a control diet (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. After a week of adaptation period, live body weight in grams was measured for all birds at the beginning of the experiment and continued every week until the end of the experiment.

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 (A.O.A.C., 2000). The metabolizable energy (ME) levels of feed ingredients was calculated using the formula ME (kcal/kg DM) = 3951 + 54.4 EE - 88.7 CF - 40.8 Ash (Wiseman, 1987).

Measurements and observations

Feed intake of each replicate was recorded daily throughout the experimental period. Individual weight of each replicates was taken once per week. The body weight measurements were used to determine pen averages and to calculate the feed conversion ratio. The average feed intake was recorded (g/day), Feed conversion ratio was calculated as gram feed intake /per gram body weight gain. 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). Daily mortality was recorded for each replicate and treatment, and then weekly mortality rate was calculated by subtracting the number of dead chicks from the number of live chicks at each interval. Feed cost per live weight gain was computed by the cost of feed consumed to attain a kilogram (kg) live weight gain.

Table 1. Ingredients of experimental diets fed to the rhode island red grower chick.

Feed ingredients	T1 (%)	T2 (%)	T3 (%)	T4 (%)	T5 (%)
DTP	0	5	10	15	20
Corn	30	28.5	27	25.5	24
Wheat bran	10	9.5	9	8.5	8
Wheat middling	27.15	25.65	24.15	22.65	21.15
Nouge cake	15	14.25	13.5	12.75	12
Soya bean	5	4.75	4.5	4.25	4
Rape seed	10	9.5	9	8.5	8
Lime stone	2	2	2	2	2
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	100	100	100	100
CP (%)	18.66	19.84	21.36	18.82	18.77
ME(kcal/kg DM)	3157.08	3087.07	3084.95	2789.60	2163.48

Source: Control diet from KAFPF (2009).

Table 2. Mean DM intake of RIR grower chicks.

Parameter	Experimental diets					SEM	P-value
	T1	T2	T3	T4	T5		
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 within a row are significantly different ($P < 0.05$).

Experimental design and statistical analysis

The experiment was arranged in completely randomized design (CRD). The data were subjected to one way ANOVA using SPSS (2002; Version.13) and SAS (2006; 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 AND DISCUSSION

Dry matter (DM) intake

The daily and the total mean DM intake of grower chicks fed with the treatment levels of DTP is presented in Table 2. The average daily dry matter intake of DTP has a significant ($P < 0.05$) difference from the control group. The maximum cumulative DM consumption per bird was 5120.50 g in the birds fed on T5. The dry matter intake of DTP was highly improved than those fed on the commercial ration alone. The result is in agreement with the findings of King and Zeidler (2004) who indicated that diet containing seed and tomato pomace had higher feed consumption than the control group. The daily DM intake of this result is in agreement with Halima et al. (2006) who reported that the mean daily feed intake of RIR chicks

was 83.3 g per head for 22 weeks. The finding is also similar to Tegene and Asrat (2009) who reported that 68 to 77 g dry matter intake per day per head for RIR chicks regardless of the diet. However, it contradicts with the report of Ayhan and Aktan (2004) and Ghazi and Drakhshan (2002) who reported that there were no significant difference in cumulative feed consumption per bird between groups fed with diets containing different levels (5, 10 and 15%) of DTP with the control group. It also disagrees with the report of El- Hassan (1999) who cited that the presence of 2.5% dried tomato pomace in the diet decreased the total feed consumption in broiler chicks. In this finding, the feed intake of birds was varied from the other experiments. However, according to the report of Ernest (1996), feed intake largely depends on factors like feed quality, palatability, climates, housing systems, health, management and other factors. DTP did not affect the DM intake of grower chicks and it improved the mean daily and cumulative feed consumption of birds. This is an advantage for producers, as DTP is regarded as a waste material that can be bought cheaply, and reduce the production cost without affecting the feed consumption. Intake improvement might be due to the higher crude fiber or lower ME content of DTP. Such fiber increases fecal bulk and speed up the passage of feed

Table 3. Body weight gain (g/bird) of RIR grower chicks.

Parameter	Experimental diets					SEM	P-value
	T1	T2	T3	T4	T5		
Initial bodyweight (g)	485.5	485.2	484	486.4	484.3	10.715	0.999
Mean final body weight (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 within a row are significantly different ($P < 0.05$).

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., 2005). To fulfill their energy requirement birds need to consume more feed. If the energy level is low the consumption and FCR are high and vice versa (Ralphsay, 1987).

Mean body weight gain

The effect of including varying levels of DTP in growers ration on body weight gain is presented in Table 3. 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. 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. The pattern observed in this study is similar to Ghazi and Drakhshan (2002) who indicated that there were no significant differences in weight gain among chicks fed 10 and 15% tomato pomace in comparison with the control group. Alkali, heat treated, and sun dried tomato pomace offered at 10% level to broilers also resulted in similar live body weight with that of the control group (AL-Betawi, 2005). The result of this study is in agreement with results reported by El-Hassan (1999) that 2.5 and 5% level of inclusion of DTP in the starter and finisher diets had significantly heavier live body weight and body weight gain than the control group. Boushy and Van Derpoels (2000) reported that DTP inclusion in the diet improves the body weight gain of broiler checks. Numerically birds fed a diet containing 10% DTP improved the mean body weight gain next to 5% DTP level, but did not brought the significant difference. 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 (Jeffre

and Firman, 2004). The most commonly deficit amino acids in grower chicken ration are lysine, 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, D 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 (Burton and Silverman, 2009). 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, 2009). The constituents of fiber affect the gastrointestinal tract differently, ultimately affecting the nutrition of the animal. 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).

According to Johnston et al. (2005), inclusions of high fiber ingredients are usually limited because of the poor metabolizable energy contents and it affects performance and nutrient utilization of chicken. High amount of crude fiber in poultry rations reduce feed efficiency, growth, egg production and time of food passage throughout the digestive system.

The use of the lower energy diets will result in a somewhat longer growing period and reduced feed efficiency (Damron and Sloan, 2009). Feeding of high fiber diets, however, is used as a strategy to control growth in some types of poultry such as turkey breeder candidates or chicken pullets to prevent excessive growth (Johnston et al., 2005). A fiber rich feed resource can be act as cholesterol reducing feedstuff in poultry product (Bordowski and Geisman, 1980).

Feed conversion ratio

Feed conversion ratio of the experimental chicks expressed as grams of feed consumption per unit body

Table 4. Partial budget analysis of RIR grower chicks

Parameter	Experimental diets					SEM	P-value
	Control	5% DTP	10% DTP	15% DTP	20% DTP		
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
Economic 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 within a row are significantly different ($P < 0.05$).

weight gain are shown in Table 3. 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. The result agrees with El-Hassan (1999) who reported that the feed conversion was significantly improved in a diet containing 2.5 to 5% DTP. The lowest feed conversion ratio measured in RIR fed the highest level of DTP (20%) is also in agreement with Rahmatnejad et al. (2009) who indicated that a feed containing 24% DTP had the worst feed conversion ratio due to high fiber content.

Economic analysis

The cost effectiveness of the unconventional feed is shown in Table 4. 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. This result agrees with report of Rahmatnejad et al. (2009), the cost per kg feed was decreased with increasing DTP in diets when compared with control group. El-Hassan (1999) reported that inclusion of tomato pomace in broiler diets with 2.5 or 5.0% level showed significant low feed cost /kg gain values as compared to control diets. Rahmatnejad et al. (2009) indicated that the cost/kg feed of treatment containing 16% DTP was lowest, due to the low price of

DTP and it had the positive effect on economic value of production. Rogelio et al. (2004) also cited that it reduces the feed cost per bird per kg gain in weight in broiler and reduces the feed cost per dozen eggs in layers. 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, 10, 15 and 20% DTP, respectively. 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.

Non significant (NS) difference

One of the most frequently cited and the foremost challenge facing in poultry production is inadequate supply and poor quality of poultry feeds and lack of systematically documented information in the value of the available feed resource base. The significance of feed availability and quality and information on alternative feed sources in poultry production cannot be overemphasized since, especially under commercial systems. Feed is the principal determinant of the economics of production (Negussie and Alemu, 2005). The cost of feed ingredients represents 60 to 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). This 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 without affecting feed intake, weight gain, feed conversion efficiency, carcass yield and

dressing percentage of grower chicks.

Conclusion

Based on the result obtained, this study concluded that the lowest and highest DM intake was 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 in the control group. Higher feed 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.

RECOMMENDATIONS

Based on the results of this study the following recommendations are made:

1. Using DTP as a feed ingredient during ration formulation for RIR grower chicks at 20% inclusion level helps to reduce the production cost and maximizes profit without deleterious effect on the overall performance of grower chicks.
2. Technology dissemination about the advantage of this feed stuff is very advisable especially for commercial poultry farm owners and intensive system broiler producers to reduce their production cost.
3. Further research on treatment of the DTP when included at higher level is necessary to know the effect of this feed stuff beyond 20% inclusion.

REFERENCES

A.O.A.C (Association of Official Analytical Chemists) (2000). Official Methods of Analysis. 13th Edition, Washington D.C.

Adeniji AA, Oyeleke MM (2008). Effects of Dietary Grit Fed on the Utilization of Rumen Content by Pullet Chicks. Department of Animal Production, University of Ilorin, Ilorin, Nigeria.

Al-Betawi NA (2005). Preliminary Study on Tomato Pomace as Unusual Feedstuff in Broiler Diets. Pak. J. Nutr. 4:57-63.

Anderson J, Perryman S., Young L. and Prior S (2010). Dietary Fiber. Colorado State University Extension. p. 1

Anjum MI, Khan AG, Azim A, Afzal M (2005). Effect of Dietary Supplementation of Multi-Strain Probiotic on Broiler Growth Performance. Animal Nutrition Programme, Animal Sciences Institute, National Agricultural Research Centre (NARC), Islamabad-45500, Animal Sciences Division, Pakistan Agricultural Research Council (PARC), Islamabad, Pakistan.

Ayhan and Aktan (2004). Using Possibilities of Dried Tomato Pomace in

Broiler Chicken Diets Süleyman Demirel University, Faculty of Agriculture, Department of Animal Science, Isparta-Turkey, Hayvansal Üretim 45(1):19-22

Bordowski DL, Geisman JR (1980). Protein Content and Amino Acid Composition of Protein of Seeds from Tomatoes at Various Stages Of Ripeness. J. Food Sci. 45:228-235.

Boushy, Van Derpoel (2000). Hand Book of Poultry Feed from Waste. 2nd edition Kluwer Academic Publishers.

Burton, Silverman (2009). adequacy of a vegetarian diet. Am. J. Clin. Nutr. 59:1238S-1241S. PubMed:8172128

Chandrasekaran D (2005). Juvenile Broiler Nutrition .Department of Animal Nutrition, Veterinary College & Research Institute Tamil Nadu Veterinary and Animal Sciences University, Namakkal. 637001.

Damron BL, Sloan DR (2009). Poultry Diets for Small Flocks. University of Florida IFAS extension. p. 1.

El-Hassan MAEC (1999). Effect of Some Agricultural Industrial Byproducts on the Performance of Broiler Chicks. Ph.D Thesis, Faculty of Agriculture, Zagazig University. Egypt.

Ernest B (1996). Practical Poultry Nutrition. IPC livestock. Barneveld College.

Fajimi AO, Babatunde GM, Ogunlana FF Oyejide A (1993). Comparative Utilization of Rubber Seed Oil and Palm Oil by Broilers in Humid Tropical Environment. Anim. Feed Sci. Technol. 43:177-178.

Ghazi S, Drakhshan A (2002). The Effects of Different Levels of Tomato Pomace in Broilers Chick Performance. Department of Animal Science, College of Agriculture, Razi University, Iran.

Geisman JR (1981). From Tomato to Resources Protein from Tomato Seeds. Ohio Rep. 66:92-94.

Halima-Hassen FWC, Nesor TD, de Kock A, Van Marle-Koster E (2006). Studies on the Growth Performance of Native Chicken Ecotypes and RIR Chicken under Improved Management System in Northwest Ethiopia. Department of Animal, Wildlife and Grassland Sciences, University of the Free State, P. O. Box 339, Bloemfontein, 9300, South Africa .ILRI, Addis Ababa, Ethiopia

Gillespie JR (1992). Modern Livestock and Poultry Production. 4th edition. Delmar publisher. inc. p. 612.

Jeffre D. Firman (2004). Nutrient Requirements of Chickens and Turkeys. National academy press Washington D.C. p. 19

Kality Animal feed Processing Factory (KAFPF) (2009). Unpublished Feed Formulation Manual. Addis Ababa. Kality. p. 1.

King AJ, Zeidler G (2004). Tomato Pomace May be a Good Source of Vitamin E in Broiler Diets. California Agric. 58:1.

Johnston SN, Antonio R, Jerry S (2005). Feeding By-Products High in Concentration of Fiber to Nonruminants. West Central Research and Outreach Center University of Minnesota. p. 15.

Ministry of Agriculture (MOA) (2006). Agricultural Bulletin (Amharic version). pp.15-18

National Research Council (NRC) (1983). Underutilized Resources as Animal Feedstuffs, National Academy Press. Washington DC, USA, pp. 23-25.

National Research Council (NRC) (1988). Nutrient SAS Institute Inc., 1998. SAS /STAT User's Guide. Edn.

Negussie D, Alemu Y (2005). Characterization and Classification of Potential Poultry Feeds in Ethiopia Using Cluster Analyses. Ethiopian Agricultural Research Organization, Debre Zeit Agricultural Research Center, P.O.Box 32, Eth. J. Anim. Prod. 5(1):125-131.

Rahmatnejad E, Bojarpour M, H.mirzadeh K, Chaji M, Asheyrizedeh MO (2009). The Effect of Different Levels of Dried Tomato Pomace on Broiler Chicken Hematological Indices Economic. Department of Animal Science, Ramin University of Agricultural and Natural Resources, Ahvaz, Iran.

Ralphs R (1987). Manual of Poultry Production in the Tropics. Published by CAB international. p. 53

Rogelio R. Caluya, Roseminda R. Sair, Grace Marjorie R .Recta and Benito B. Balneg (2004). Tomato Pomace as Feed for Livestock and Poultry. p. 4

SPSS (2002). Statistical Package for Social Science, SPSS 13 for Windows. SPSS Inc. Chicago, Illinois.

Statistical Analysis Software (SAS) (2006). Statistical Analysis Software Enterprise Guide Version 6.12, SAS Institute Inc., Cary NC.

Tegene N, Asrat T (2009). Effects of Feeding Different Levels of

Cooked and Sun Dried Fish Offal on Carcass Traits of Growing Rhode Island Red Chicks. College of Agriculture, Department of Animal and Range Science, Hawassa University, P.O. Box 05, Hawassa, Ethiopia .Agricultural Technical Vocational Education and Training College, P. O. Box 120, Wolaita Soddo.

Tewe OO (1997). Sustainability and Development Paradigm from Nigeria's Livestock Industry. Inagural lecture delivered on behalf of Faculty of Agriculture and Forestry, University of Ibadan, Nigeria.. The Ensminger Publishing Co., Clovis, CA, USA. p. 50

Upper Awash Agro industry (UAAI) (2009). Amount of Processing Tomato. Unpublished progress reportl .Upper Awash Agro Industry, Merti. p. 3

Wiseman J (1987). Feeding of Non-Ruminant Livestock. Butterworth and C. Ltd. p. 370