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Studies on the Effect of Guava Leaf Meal on Growth Performance and Body Composition of Golden Misri Chicks

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ABSTRACT

Guava (*Pisidium guajava)* is a common tropical fruit cultivated in many tropical and subtropical regions. The present study was conducted to analyze the effect of guava leaf meal on growth performance and body composition of golden misri chicks (*Gallus gallus*). Ten days old, fifteen golden misri chicks were purchased from a local hatchery in Faisalabad and were divided into three treatments after weighting. The treatment T_1 was the control group and fed to only a diet without additives, T_2 and T_3 were experimental groups in which T_2 was served a basal diet with 9g of guava and T_3 was fed to a basal diet with 18g of guava as an additive. The dietary phase was categorized into two phases; the grower phase and the finisher phase. In the grower phase, chicks were fed a commercial diet and in the finisher phase, the chicks were served with a manually prepared diet. The time duration of the whole research trial was 40 days. The growth performance such as average weight gain, feed intake, feed conversion ratio and specific growth rate were determined on a weekly basis. The body composition in which crude protein was determined by the micro Kjeldahl method, crude fat was determined by the Soxhlet method, moisture was measured by using a drying oven and ash was determined with the furnace at 600ºC by using Soxhlet apparatus. The results revealed that average weight gain increased significantly ($P<0.05$) in T_3 61.5±4.09 and decreased in T_1 59.32±19.0. The FCR rate was maximum in $T_3$1.62±0.40 and was minimum in $T_1$1.91±0.45.The feed intake ratio was maximum in treatment $T_3$109±30.83 and was minimum inT_1 103±8.82. The specific growth rate was

maximum in T_3 0.58±0.009 and was minimum in T_1 0.57±0.055). The crude protein was higher in T_3 22.5±0.925 was minimum in T_1 20.14±0.625). Crude fat was lower in T_3 5.61±1.73and was higher in T_1 7.44±0.06). Moisture content was maximum in T_1 70.5±0.06 and was minimum in T_3 62±1). Ash content was higher in $T_3$1.39±0.01 and was lower in T_1 1.16±0.01). The whole data was analyzed by using a one-way analysis of variance (ANOVA).

Keywords: Guava, golden Misri chicks, crude protein, Soxhelt

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INTRODUCTION:

Chicken meat is considered a vital animal-based protein source containing vital amino acids, fats, carbohydrates and minerals needed for optimum growth and maintaining the body's metabolism (Chia *et al*., 2019). Chicken is better source of white meat that contains beneficial omega-3 that is essential for the normal functioning of vital organs of the body (Enahro*etal.*, 2018; Jankovic *et al*., 2020; Kasule *et al*., 2018; Van Harm *et al*., 2019). The production of chicken strains provides a significant platform to get essential micronutrients and amino acids needed for optimum growth and efficient body metabolism of animals (Choe *et al*., 2009). The resources and management required for the maintenance of local as well as commercial chickens including broilers, the rate of meat consumption in order to get an efficient protein source and efficient meat texture is the prime objective to fulfill the requirement of people (Wattanachant *et al*., 2004; Guan *et al*., 2013; Jaturasitha *et al*., 2017).

The poultry sector plays a significant role in overcoming the food shortage in Pakistan. Pakistan's population is growing at the rate of 2.14% per year which is stabilized by the Poultry farming system efficiently with the availability of proteins, minerals, vitamins and micronutrients (Manan *et al*., 2013). Poultry development plays a significant role by providing manageable and cheaper means of protein and employment (Bachya *et al*., 2012). The production of meat during 2014-15 in Pakistan was nearly 0.96-1.08 million tonnes of food to compensate for the requirements of the population. Feed supplementation has made a tremendous contribution to the poultry industry for long a time by enhancing animal growth and also with the improvement of feed conversion ratio of animals (Williams, 2001). The feed supplementation comprises plant leaf extracts like peel and pulp both contain dietary fiber contents (48.55-49.42%) and extractable polyphenols (2.62-7.79%), also contain flavonoids, vitamins, fatty acids and phenols (Geidam*et al.*, 2007).

Guava (*Psidium guajava)* is a common small tropical tree growing up to 35 feet in length its cultivation is higher in the tropics to get fruit. Its family is Myrtaceae having 133 genera and more than 3800 species. The plant body parts of guava have been used for a long in medicinal history and also have higher applications in the modern era (Nwinyi *et al*., 2008). The chemical analysis reveals that guava foliage volatile oils obtained were -pinene (11.77%), 1, 8-cineol (9.22%), globular (5.88%), hexenal (5.03%), epi-bisabolol (10.85%), 1-epi-cubenol (4.56%) and terpipineol 4.35% (Ramadan *et al.*, 2009). The Guava plant extract has played an important role in agro-industrial sectors having vast and unique utilization as feed additives in Pakistan, Egypt

and other countries. The maximum efficiency of guava as a medicinal activity is referred to as flavonoids because it contains a higher effective mechanism to kill the bacteria that harm poultry animals. Many human diseases like diarrhea, malaria, gonorrhea, burns, stomach diseases and other infectious diseases have been cured by the utilization of plants (Toghyani *et al.*, 2011).

The crude guajava extracts (250, 500 and 750 mg/kg) provide protection from diarrhea in guinea pig, similar to loperamide, a standard antidiarrhoeal agent) and ethanol extract of guava leaf protected diarrhea up to the level of 55.6% (Porwal*et al.*, 2012). The antibiotic alternative source which is guava (*Psidium guajava*) can enhance the variety of defense mechanisms efficiently against various pathogens (Ljubojevic *et al*., 2016). The utilization of guava as an antibiotic source in agricultural and poultry sectors in the European Union and also in other countries still has established significant growth production and body composition parameters of farm animals (FAO, 2016).

The body composition of chickens is also an important physiological parameter to determine and evaluate the vital components of the body like proteins, carbohydrates, lipids, and ash and moisture contents. The significant concentration of guava as a feed additive elevates the growth performance and maintains the level of proteins and carbohydrates in chickens (Sahito *et al*., 2010). The supplementation of guava (*Psidium guajava*) as dry leaf extract reduces the concentration of unnecessary fatty acids not in LDLs but in addition, feeding the dried guava leaf accelerates the immune system in birds, higher protein contents, globulin and significant amount of leukocytes (Madina *et al*., 2006).

The objective of this study is to investigate the effect of guava leaf meal on growth performance and body composition of golden misri chicks (*Gallus gallus*). Growth performance feed utilization in terms of weight gain, feed intake ratio, feed conversion rate and specific growth rate.

MATERIALS AND METHODS:

Housing and management: This experimental trial was conducted at (PARS) Post agricultural research station at University of Agriculture, Faisalabad. Before starting the trial, experimental area was cleaned and disinfected properly. The feeder and drinker apparatus were completely cleaned and dried under the sun. In the cage, proper litter dispersal was entertained. On regular basis, temperature and humidity were monitored.

Experimental birds: For the purpose of research trial, total fifteen chicks were purchased from local hatchery of Faisalabad. Chicks were ten days old. Chicks were vaccinated before the initiation of experiment according to schedule.

Experimental design and feeding trial: The total 15 chicks were arranged into three treatments such as T_1 was the control group and the other two T_2 and T_3 were designed as experimental groups. The chick's dietary phases were categorized into grower and finisher periods according to the nutritional requirements of chicks. The guava leaf meal powder was used in the diets of experimental groups. The experimental diets were designed as

T_1: 360g basal diet during the starter period and 710g basal diet during the finisher period.

T_2: 360g basal diet with 9g guava during the grower phase and 710g basal diet with 9g guava during the finisher period.

T_3: 360g basal diet with 18g guava during the grower phase and 710g basal diet with 18g guava during the finisher period.

Table 1: Composition of experimental Commercial fed to chicks during 1st phase.

Feed ingredients	T_1 (0%)	T_2 (9g guava leaf meal as mesh form)	T_3 (18g guava leaf meal as mesh form)
Maize	56.00	56.00	56.00
Soya bean meal	26.70	25.10	25.10
Rice polish	14.60	13.60	12.60
Soya bean oil	3.30	3.50	3.50
DCP	0.65	0.60	0.60
Guava leaves	0.00	2.5	4.5
Salt	0.25	0.25	0.25
Vitamin- mineral premix	*	*	*
Total	100	100	100

Table-2: Composition of experimental mesh feed fed to chicks during 2nd phase.

Feed ingredients	T_1 (0 %)	T_2 (9gguava leaf meal as mesh form)	T_3 (18g guava leaf meal as mesh form)
Maize	60.30	60.00	60.00
Soya bean meal	24.50	20.73	21.00
Rice polish	12.70	9.70	9.70
Soya bean oil	2.50	2.00	2.74
DCP	0.60	0.60	0.60
Guava leaves	0.00	2.5	4.5
Salt	0.25	0.25	0.25
Vitamin- minerals premix	*	*	*

Total	100	100	100

Feeding trial

The chicks feeding trial was categorized into many feeding stages. In the first phase, commercial feed was used including Acclitimization period, while in second phase the formulated feed was used.

First phase

The first phase was started from day1 and then ended in 20-day old chicks.

Feeding trial for first phase

1-10 days, Acclitimization period only commercial feed given, at 11-20 days T_1 (360g commercial diet), T_2 (360g commercial diet+ 9g guava leaf meal as mesh form), T_3 (360g commercial diet + 18g guava leaf meal as mesh form).

Second phase

The second phase was started from day 21 and ended in 40-day old chicks.

Feeding trial for second phase

From 21-40 days, T_1 (710g Formulated diet), T_2 (710g Formulated basal diet + 9g guava leaf meal as mesh form), T_3 (710g Formulated basal diet + 18g guava leaf meal as mesh form).

Proximate Growth Rate

Body weight and feed intake ratios were accessed during 11-25and 25-40 days of age. From observed data feed conversion ratio and specific growth rate were determined. At the end of experimental trial, the following parameters were calculated.

1. Body weight gain

Initial weight of the birds was measured on the arrival on research place by using digital weighing system. The average weight gain of birds was measured on a weekly basis such as the 11^{th}, 18^{th}, 25^{th}, 32nd, and 40^{th} day.

Body weight gain was determined by using the following formula:

Body weight gain (%) = final weight –starting weight / starting weight x 100

2. Feed Intake:

The feed intake ratio was evaluated and measured by subtracting the amount of feed consumed from the quantity of feed provided for birds in each group on the 11^{th}, 18^{th}, 25^{th}, 32nd, and 40^{th} day respectively. It was measured by using the following formula.

3. Feed conversion ratio

The feed conversion ratio (FCR) was evaluated to analyze the feed performance of chicks. Feed conversion ratio (feed/gain) was calculated on the 11^{th}, 18^{th}, 25^{th}, 32nd, ad 40th day, using he folloing reationship.$= \frac{\text{Feed intake (g)}}{\text{Weight gain (g)}}$

4. Specific growth rate (SGR):

The specific growth rate of birds was measured by taking the growth measurements of the first week and final weeks so that the ideal growth rate of birds in each group can be evaluated. The specific growth rate was measured by using the following formula.

Specific growth rate = (final weight (g) – initial weight (g) / Experimental birds

Body composition

Chicks were selected randomly from control and treated treatments. Chicks were allowed for dissection and body composition such as crude protein, fats, ash, and moisture contents were evaluated and determined by the utilization of (AOAC 1999) method. The protein was determined by Kjeldahl's method. At 70°C for 34 hours with the utilization of the oven drying method, the moisture was measured easily. Ash was determined with a furnace at 600^{o}C and by using the Soxhlet apparatus fat was determined.

Crude protein test

For the estimation of crude protein 2 gm sample of feed was placed into tissue paper. For this process, 5g of digested mixture was added. This process was processed in Kjeldahls's Mask. To conduct this experiment efficiently 30ml commercial sulphuric acid was added. The time required to heat the whole mixture was nearly 3 to 3.5 hrs. After completion of the heating process, the mixture was allowed to cool for 30 minuts. After cooling the mixture produced a light green colour. The next step for the estimation of CP is distillation. To develop the 250ml cooling digestion flask, distilled water was added to the cooled mixture. After taking that measure 10ml of distilled water was added in the Kjeldahls's Mask. 40% 5 ml of NaOH was added to it. Distillation was made possible by countering the 10ml of Boric acid. The time came when the color of Boric acid was vary from pink to yellow by getting the vol 30ml then the mixture was titrated against 0.1 N H2SO4. After carrying distillation was complete, the solution was titrated with 0.1 N H2SO4 which was placed in burette finally changing the color of the solution to white. The volume used was calculated.

Moisture test

Petri dish weight was made ensured (W_1). The conc of the sample which was taken 3g into petri dish for 120 hrs and placed in the oven. After taking the task, the Petri dish was allowed to take 10-15 minutes in desiccators. The weight of the sample was made to ensure which was kept in a Petri dish (W3). Moisture of the sample was evaluated.

Crude fat test

The conc. of the sample was selected as 5g which was wrapped into paper. The present sample was allowed to put the Sox let flask. The flask was saturated to 250ml of ether conc. The water supply was made possible through condensers and flasks. The extraction method required nearly 3-3:30 hours. The sample was displaced and was allowed to evaporate so that it could be achieved properly. The obtained dry fat was evaluated and weighed.

Ash Test

The sample was taken and placed in a china dish (only china dish weight was already measured) which was allowed to be kept in muffle furnace for 11-13 hours at a temperature of 550°C and then china dish weight which carrying sample was measured again to determine the ash content.

Statistical Analysis:

Whole obtained data was analyzed by using one-way analysis of variance (ANOVA).

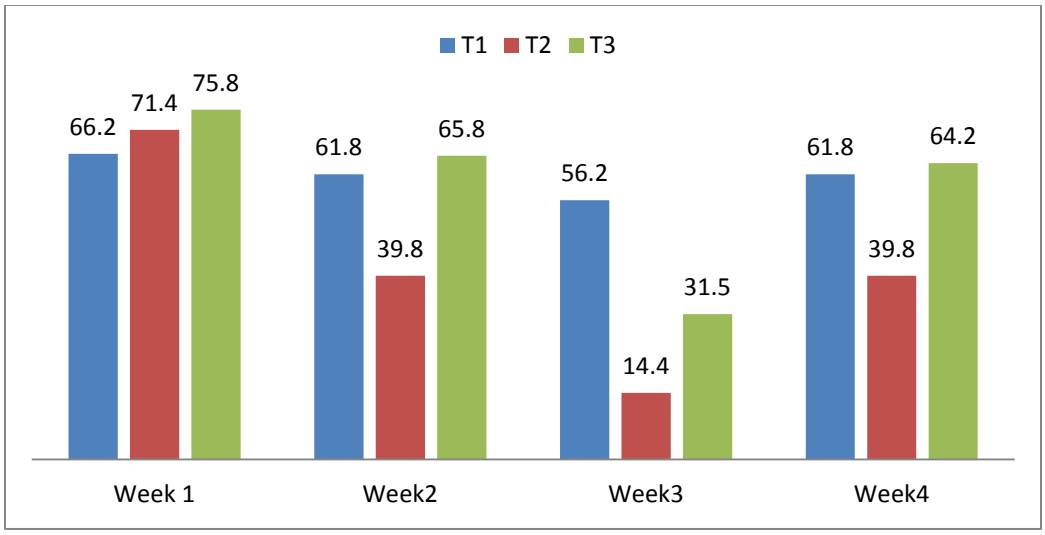
RESULTS:

Table 3: Effect of guava leaf meal on Average weight gain of golden misri chicks during all research weeks

Feed Types.	Duration	Date	T_1 (control diet without guava leaf meal extract)		T_2 (control diet with 9g guava leaf meal extract)		T_3 (control diet with 18g guava leaf meal extract)	
			Average body weight (g)	Average weight gain (g)	Average body weight (g)	Average weight gain (g)	Average body weight (g)	Average weight gain (g)
*	Initial weight	20-06-2021	……..	……..	……..	……..	…….	…….
Commercial diet	Week1	27-06-2021	132.2	66.2	123.2	71.4	130.4	75.8

Commercial diet	Week 2	04-07-2021	198.6	61.8	194.6	39.8	206.2	65.8
Manual diet	Week 3	11-07-2021	260.4	56.2	234.4	14.4	271.5	31.5
Manual diet	Week4	18-07-2021	316.6	61.8	248.8	39.8	303	64.2
Mean ±S.D		……	226.95±79.45	55±4.09	200±56.24	41.35±23.33	227±76.41	59.32±19.24

Table.3. shows the comparative analysis of average weight gain in which overall treatment T_3 of four weeks shows a higher value compared to T_2 and T_1 of four weeks. Treatment T_3 during weeks 1 and 2 of commercial dietary phases have values of 75.8, and 65.8 respectively. During the manual prepared dietary phase of week 3 and week 4 T_3 has 64.2 and T_1 has 61.8respectively. The mean standard value of T_3 overall is a maximum of 59.32±19.24 and minimum value is 55±4.09.



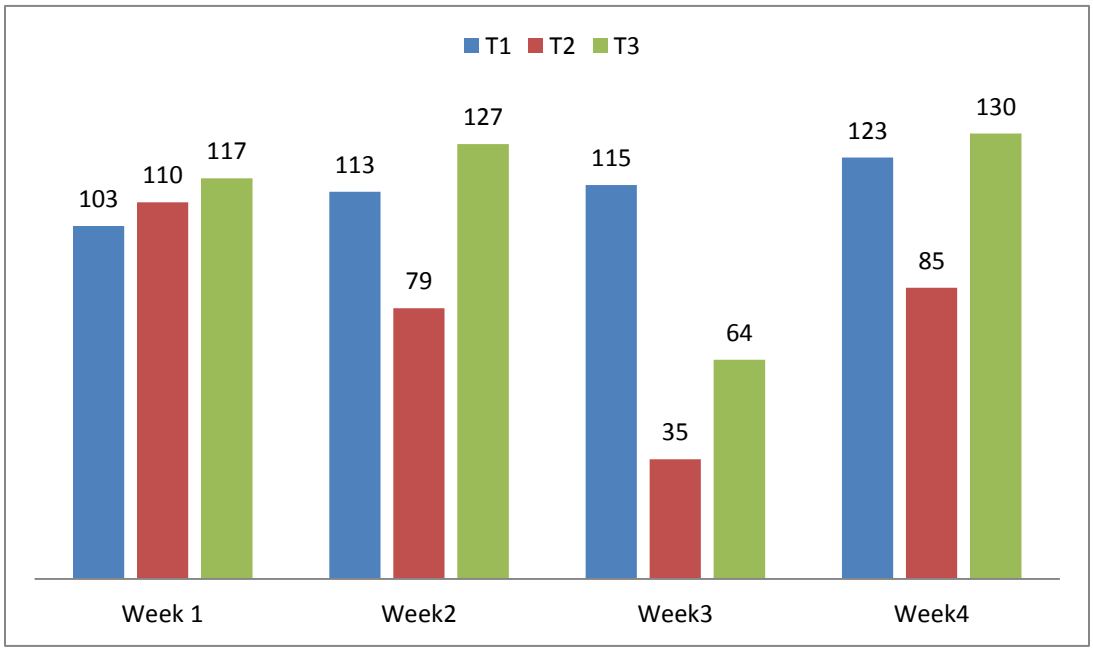
Effect of Guava Leaf Meal on Average weight gain of Golden Misri chicks during whole research weeks

Table 4: Effect of guava leaf meal on Feed intake ratio of golden misri chicks during all research weeks

Feed Types	Duration	Date	T_1 (control diet without guava leaf meal extract)		T_2 (control diet with 9g guava leaf meal extract)		T_3 (control diet with 18g guava leaf meal extract)	
			Average feed intake (g)	Average FCR	Average feed intake (g)	Average FCR	Average feed intake (g)	Average FCR
Commercial Diet	Week 1	27-06-2021	103	1.55	110	1.54	117	1.54
Commercial Diet	Week 2	04-07-2021	113	1.82	79	1.93	127	1.98
Manual prepared Diet	Week 3	27-06-2021	115	2.04	35	2.5	64	2.03
Manual prepared Diet	Week 4	04-07-2021	123	1.10	85	2.13	130	2.09
Mean ±S.D …….		……	113±82 2	1.62±0.40	77.25±31.20	2.02±0.40	109±30.83	1.91±0.25

Represents the comparative analysis of treatments related to feed intake served with commercial and manual prepared feed during the first two weeks and final two weeks. Overall the treatment T3 from all the research weeks shows a maximum feed intake 117, 127, 64, and 130 respectively compared to other treatments T1 and T2 103.113 and 123 respectively. The mean standard value

of treatments such as T3 has 109±30.83, T2 treatment shows 77.25±31.20, and treatment T1 has 113±822 respectively. The overall feed intake rate is significantly higher in treatment T3 compared to treatment T1 and treatment T2.



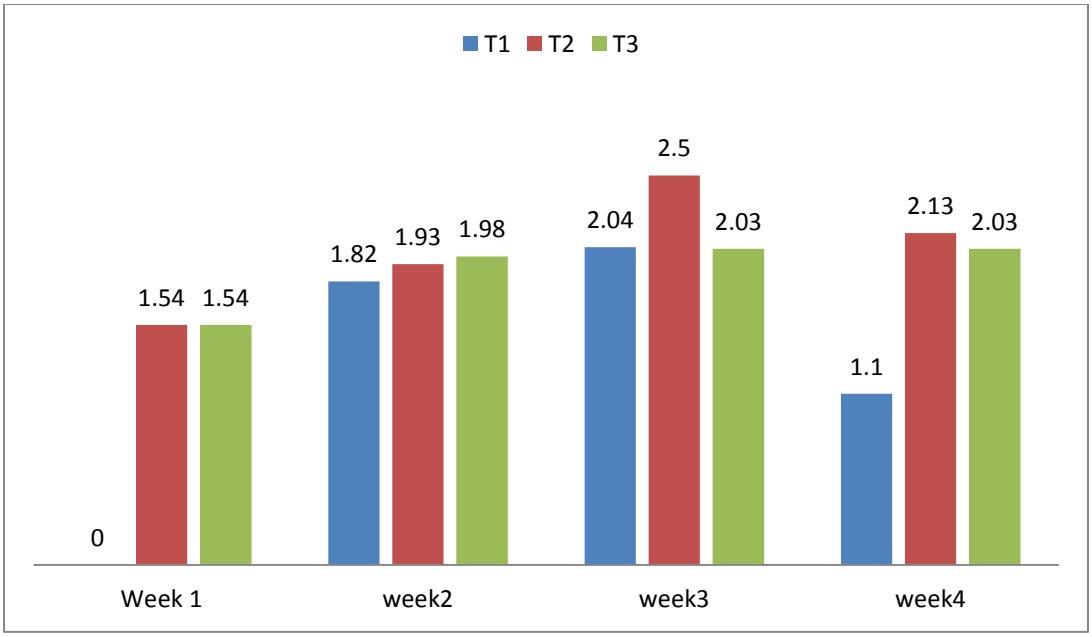
Effect of guava leaf meal on feed intake rate of golden misri chicks during whole research weeks

Table 5. Effect of guava leaf meal on feed conversion ratio of golden miri chicks fed to commercial and manual prepared diet during whole research weeks

Feed Types	Duration	Date	T_1 (control diet without guava leaf meal extract)		T_2 (control diet with 9g guava leaf meal extract)		T_3 (control diet with 18g guava leaf meal extract)	
			Average feed intake ratio (g)	Average FCR	Average feed intake ratio (g)	Average FCR	Average feed intake ratio (g)	Average FCR
Comme	Week 1	27-	103	1.55	110	1.54	117	1.53

rcial Diet		06-2021						
Commercial Diet	Week 2	04-07-2021	113	1.82	79	1.93	127	1.98
Manual prepared Diet	Week 3	27-06-2021	115	2.04	35	2.5	64	2.03
Manual prepared Diet	Week 4	04-07-2021	123	1.10	85	2.13	130	2.09
Mean ±S.D ……..		…….	113±8.22	1.62±0.40	77.25±31.20	2.02±0 40	109.5±30.83	1.91±0.25

Table shows the comparative relationship between treatments related to feed conversion ratio fed to commercial and manual prepared diet. Week 1, T_3 shows a higher FCR ratio 1.53 compared to T_1. T_1 in week 2 shows maximum FCR1.82 and inweek3 T_3 has maximum FCR 2.03 and in week4 T1 shows maximum FCR1.10. The mean standard value of the T_1 treatment is 1.62±0.40, the treatment T_2 has 2.02±0.40 and T_3 shows 1.91±0.25 respectively. The overall the FCR rate was significantly increased in T_3 during the commercial and manual dietary phase.



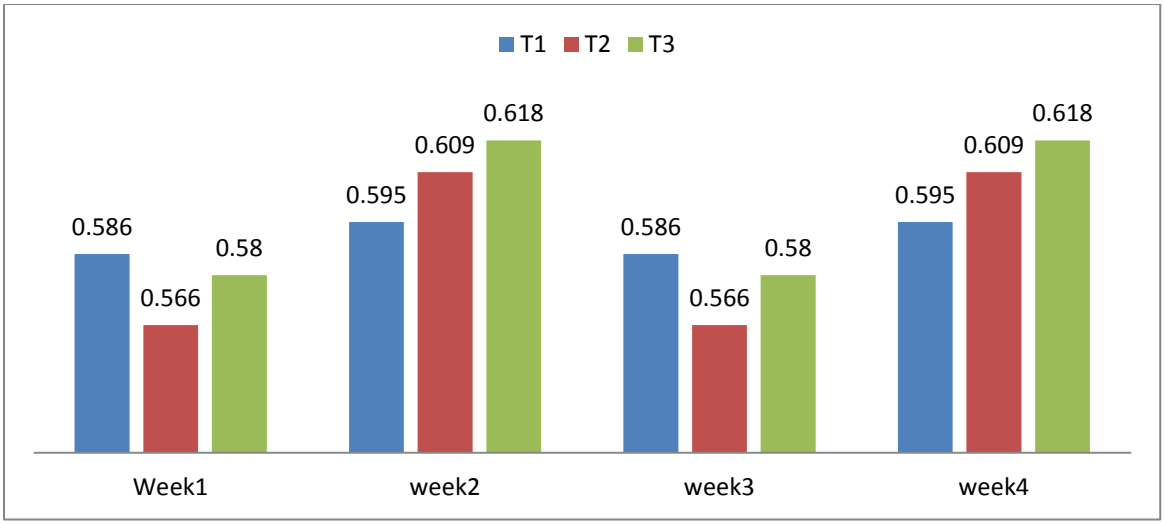
Effect of guava leaf meal on FCR ratio of golden misri chicks during whole research weeks

Table 6: Effect of guava leaf meal on specific growth rate of golden misri chicks fed to commercial and manual prepared diet during all research weeks

Feed Types	Duration	Date	T_1 (control diet without guava leaf meal extract)	T_2 (control diet with 9g guava leaf meal extract)	T_3 (control diet with 18g guava leaf meal extract)
			Specific growth rate	Specific growth rate	Specific growth rate
Commercial Diet	Week 1	27-06-2021	0.586	0.566	0.580
Commercial Diet	Week 2	04-06-2021	0.595	0.609	0.618
Manual prepared Diet	Week3	11-07-2021	0.589	0.526	0.595
Manual	Week 4	18-07-2021	0.575	0.38	0.492

prepared Diet					
Mean ±S.D		……	0.57±0.009	0.52±0.099	0.58±0.055

Table demonstrated the comparative analysis of specific growth rate (SGR) among treatments of golden misri chicks fed to commercial and manual diet during all research weeks in which T_1 from week has a maximum SGR value of 0.586, in week 2 T_3 shows maximum value of 0.618 than other treatments. In week 3 T_3 has a maximum value of 0.595 and T_1 in week 4 shows a maximum value of 0.575.The mean standard value of treatment T_3 is a maximum 0.58±0.055 and is minimum in treatment T_1 which is 0.57±0.009. Overall, the SGR rate is significantly higher in treatment T_3 compared to T_1 and T_2 treatments.



Graph: Effect of guava leaf meal on SGR of golden misri chicks during whole research weeks

Table 7: Effect of guava leaf meal on body composition of golden misri chicks (Mean±S.D)

Body composition	Mean ±S.D		
	T_1	**T_2**	**T_3**
Crude protein	20.14±0.625	20.5±0.5	22.5±0.925
Crude fat	7.44±0.06	6.70±0.02	5.61±0.173

Moisture	70.5±1.72	65±0.5	62±1
Ash	1.16±0.01	1.26±0.01	1.39±0.01

The table shows the comparative analysis of body composition parameters of golden misri chicks which fed commercial and manually prepared diets during the first phase and second phases. The crude protein ratio is higher in T_3 22.5±0.925 and lower in T_1 and T_2 20.14±0.625, 20.5±0.5. Crude fat is maximum in T_1 7.44±0.06 and minimum in T_3 5.61±0.0173. Moisture contents are higher in T_1 70.5±1.72 and lower in T_3 62±1. Ash content is maximum in T_3 1.39±0.01 and minimum in $T_1$1.16±0.01.

DISCUSSION

The results of the present study showed that the highest weight gain was achieved in T_3 (70.8±7.07) which was treated with a commercial diet, guava leaf meal, and the lowest weight gain was attained in T_1 (165.6±32.2) with a commercial diet without guava herbal extract. With formulated feed, the maximum weight gain was attained in T_1 (59±3.95) and the lowest weight gain was observed in T_3 (47.48±23.12). The improvement in weight gain may be associated with higher dietary fiber contents in guava leaf meal extract which efficiently increases the digestion and absorption of feed such as fats, protein, and carbohydrates. The higher availability of nutrients may result in improved weight gain of golden misri chicks also the antimicrobial properties of guava contain anti-oxidant compounds that maintain the health status of chicks. The increased nutrient absorption in chicks may result in improved weight gain in golden misri chicks. These results are related to the study of Kaileh *et al*.(2007) who revealed that the addition of guava leaf meal in a feed of native chickens improved body weight gain at a higher level. These results were correlated with the work of Li *et al*. (2014) who revealed that guava treatments significantly increased the growth in broilers.

The results of feed intake showed that chicks in the control treatment T_1 had a higher value (108±7.07) which was treated with commercial feed and lowest in T_3(1.76±0.31) with commercial feed, guava without guava leaf meal as a feed additive. The maximum feed intake was attained in T_1 (119±5.65) which was treated with formulated feed and the minimum feed intake ratio was achieved in T_3 (2.05±0.04) with formulated feed with guava leaf meal extract. This may be due to the tendency of guava leaf meal extract to improve digestion and metabolic activities. Additionally, guava leaf meal powder is richest in phenolic compounds, vitamins, carotenoids, alkaloids, and amino acids. At a lower feed intake rate, a nutrient requirement was satisfied. This finding is similar to Begum *et al*. (2004) who reported that the control treatment had a higher feed intake ratio compared to the treatment group treated with guava leaf meal fed to native chickens. Results obtained are related to the study by Srivastava *et al*. (2013) suggested

that the addition of 2% guava as an additive in the broiler diet decreased the feed intake rate compared to the control treatment. These findings are similar to the work of Mahmoud *et al*. (2013) who reported that the incorporation of 1% guava leaf meal in diets showed a significant increase in body average body weight, average weight gain, and feed conversion ratio and decreased feed intake ratio in broiler chickens. Rattanaphol and Rattanaphol (2009) and Wedy (2012) declared that the use of 0.04% or 0.06% of guava leaf extract in poultry ration didn`t have significant effect on BW and weight gain. This may be related to the low guava leaf extract or the type of extract. (Kamel *et al*., 2016), chicks fed a diet containing 20% GW had a lower feed intake ratio in experimental treatments compared to control treatments.

The feed conversion ratio of golden misri chicks was decreased in the control treatment and increased in the treatment which was treated with guava leaf meal. Minimum FCR was attained in T_1 (1.65±0.09) which was treated with a commercial diet and maximum FCR was achieved in T_3 (1.76±0.31) which was treated with a commercial diet with guava leaf meal as a feed additive. The maximum FCR rate was observed in T_3 (2.05±0.04) which was treated with formulated feed with guava leaf meal and FCR was minimum in T_1 (1.57±0.66) This may be due to the addition of guava which contained bioactive compounds that may play a vital role in improvement in efficient nutrient utilization in T_3. These anti-nutritional phytochemical substances in guava may improve FCR. These results are similar to the work of El-Deel *et al*. (2009) the feed conversion ratio was increased significantly in experimental treatments when guava by-product 2.5 and 4.5% was added to the diet of broiler chickens other than guava by-product concentration of nearly 6 to 8%. The results of El–Deek and Gadalla both represented that broiler chickens fed to up to 4.5% guava by-product significantly maximize the FCR rate similar case was seen in country chicks where golden misry chicks were fed to guava from 2.5 and 4.5% level by-product in diet significantly increased the feed intake ratio as well as feed conversion ratio. Squires *et al*. (1992) reported that alkali-treated guava leaf meal significantly increased the feed conversion rate in broiler chicks when fed to the optimum limit of 2.5 to 4.5% guava by-product. These results are interrelated to the work of Mahmoud *et al*. (2013) revealed that dietary supplementation of 1% dried guava leaves in diets had a significantly improved effect on body weight, weight gain, feed conversion ratio, and healthy status, but did not affect feed consumption of broiler chicks. These findings are similar to the work of Rahman *et al*. (2013), who found that the inclusion of guava leaf meal (2.5, 3.5, and 3.5%) in broiler diets did not significantly affect feed intake, but the mortality rate was decreased with an increased level of guava leaf meal up to 4.5% in broiler diet. These results are related to the findings of Fernandez *et al.* (2002) that guava leaf meal extract when provided to chicks in the diet significantly increased the FCR rate compared to control treatments. The increased FCR might be credited to the rich contents of nutrients in guava leaf meal extract (Sarwatt *et al.*, 2004; Kakengi *et al*., 2003). These findings are related to the study of Safa and Tazi (2012) who reported that the feed conversion ratio for chicks with guava leaf meal was increased in layer chicks. This finding is related to the study of El-Deek et al. (2009) and Zaminur *et al*. (2013) who used guava by-product in broiler finisher diets and reported that the addition of 2% guava

leaf meal extract significantly increased the FCR ratio in experimental treatments compared to the control treatment. These results are similar to the study of Marquina *et al*. (2008) and El Deeket al.(2009b) found that feeding guava by-product (GBP) improved the FCR ratio in experimental treatment when chicks were treated with guava leaf meal extract up to 2-4% in the diet.

The results of the present study showed that the specific growth rate (SGR) of golden misri chicks increased in T_3 (0.59±0.02) that was fed commercial feed with guava leaf meal extract as a feed additive and was minimum in T_1 (0.57±0.06) with commercial diet. The specific growth rate with formulated feed showed maximum SGR achieved T_1 (0.582±0.009) treated with only formulated feed. The minimum SGR rate was attained in T_3 (0.544±0.733) treated with formulated feed with guava leaf meal extract in the diet. This may be due to guava leaf meal powder which has direct interaction with the gastro-intestinal tract and modifications in gut micro-flora maximizing the feed digestibility and growth rate and the presence of phenolic compounds in guava enhancing digestion and making the gut environment suitable for optimum digestion and absorption of nutrients (Ramadan *et al.*, 2009). These results are similar to the findings of Richard *et al*. (2013) demonstrated that the leaves of the *P. guajava* plant solutions were effective for better specific growth rate of chicks. In addition, it also reported that ethanol extract from guava leaf protected diarrhea up to the level of 55.6% (Porwal *et al*., 2012). These results agreed with similar reports which have established an increase in gut physiology as being the mechanism by which many antidiarrheal agents act (Ezekwesili *et al*., 2010). These results are similar to the work of Gunal *et al.(*2006) and Agboola *et al*.(2015) who reported that supplementation of guava leaf meal extract significantly increased the specific growth rate in chicks. These results are related to the work of Mailoa *et al*. (2014) who described that the addition of guava leaf meal in chick's diet increased the specific growth rate. These results are related to the study of David *et al*. (2012) who reported that the addition of guava leaf meal powder in broiler chicks has the potential to improve the specific growth rate. This finding is similar to the work of Abiola and Adekunle (2002) reported that high-fiber diets increased the specific growth rate in treatments. The same results were derived by Farran *et al*. (2005) who reported that a 6 to 8% addition of guava leaf meal in a chick's diet increased the specific growth rate. Consequently, the birds have to increase their intake to meet energy requirements. It appears that the utilization of raw and treated guava by-products by broiler chickens is limited by its high crude fiber content. This finding is related to the work of Taher (1986) who reported that the addition of guava leaf meal in a chick's diet increased the specific growth rate. Similar results were obtained by Gunya *et al*. (2019) who reported that the addition of guava to a chick's diet increased the feed conversion ratio leading to an increase in specific growth. This finding is similar to the study of Nain *et al*. (2007) who reported that the addition of guava leaf up to 4% in diet increased the digestion and absorption and led to a higher specific growth rate in chicks. Guava leaves are known to contain vitamin C and other phytochemicals with antioxidant properties that maintain the health status in chicks as well as increase gut digestibility to optimum level resulting the increased specific growth rate (Suntornsuk *et al*., 2002, Begum *et*

al., 2002 and Qian, and Nihorimbere, 2004).

The results of the present study showed that the body composition of golden misri chicks (Gallus gallus) such as protein was maximum in T_3 (22.5±0.925) as compared to other treatmentsT_1 (20.14±0.625) without guava leaf meal extract. This may be due to Increasing total proteins and globulin levels with the inclusion of GW in the diet might be due to its high content of neutral detergent insoluble nitrogen (NDIN), offering available nitrogen for rumen microorganisms and consequently increased protein absorption in the intestine (Braga *et al*., 2016). This also may be due to the majority of enzymes (papaya peptidases and papain A and B in P&GLM) coordinated with the efficient physiological role of gut structure facilitated the better elimination and absorption of digestible nutrients such as protein units as well as the energy needed for optimum growth and development. The fat content was decreased in T_3 (5.61±0.173) treated with guava lea meal and was increased in T_1 (7.44±0.06) treated without guava lea meal extract. This may be due to phytonutrients in guava that stimulate the release of pancreatic sap which secretes the lipase enzymes to break the fatty acids and glycerol that may decrease the fat contents. These results are related to the work of Affiku and Obge (2012) who reported that 16.01% crude protein and a suitable amount of crude fiber 6.09%, ash 5.93% in guava leaf meal. These results are related to the work of El- Deek*et al*. (2009) who stated that when the concentration of guava leaf meal was kept at a ratio of 2.5 to 4.5% in their diet the abdominal fat contents were significantly decreased in birds were fed to guava leaf meal by-product. The decreased fat content in treatments T_3 may be due to utilization of guava leaf meal because guava leaf meal contained PUFA which stimulated the efficient stimulation of fatty acid oxidation and also released the unnecessary fat from the body. Moisture contents were decreased in T_3 (62±1) treatment ash increased in increased in T_1(70.5±1.72) as compared to other treatments. This result is similar to the work of Nuhu (2010) who reported the values of crude fat, crude protein, and ash to be 3.20, 22.50, and 6.50% respectively in treatments that were treated with guava leaf meal extract. This finding is similar to the work of Mahmoud *et al*. (2013) declared the different values of Ash content from Breast meat of broiler chicken in control and experimental in such order control had 0.22±0.01, T_2 contained 0.17±0.01 and T3 had 0.22±0.02. They reported that the addition of 0.4% to 1% guava leaf meal extract significantly decreased the ash contents in experimental groups. These results are encountered to the results of Gadalla and El-Deek (2009) who reported that the addition of guava leaf meal extracts up to 2.5 to 4.5% significantly increased the ash contents in experimental treatments. These results are similar to the work of (Peters *et a*l., 2012) who reported that the addition of guava up to 3.5 to 4.5% increased the ash contents in chicks. From the above discussion, it concluded that guava lea meal extract from a limit of up to 2.5 to 4.5% is a very effective concentration to improve the growth performance and body composition of golden misri chicks.

CONCLUSION

The incorporation of guava (*Psidiumguajava*) leaf meal at an optimum concentration in the diet of golden misri chicks (*Gallus gallus*) had a significant nutritional role without any harmful effects on poultry animals as well as domestic chickens. The normal concentration of guava leaf meal up to 2.5 to 4.5% gave efficient results in the form of better growth performance and body composition of golden misri chicks. The guava leaf meal extract contained a higher number of antioxidants, crude dietary fibers, and phenol compounds which significantly enhanced the digestion and absorption in chicks resulting in optimum metabolism and decreased pathogenic effects. The significant amount of dietary guava increased the crude protein and decreased the crude fat contents in golden misri chicks.

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References

Chia, S.Y., Tanga, C.M., van Loon, J.J., Dicke, 2019. Insects for sustainable animal feed:

Inclusive business models involving smallholder farmers. Curr. Opin. Environ. Sustain. 41, 23−30.

Geidam, Y., A. Ambali and P. Onyeyili. 2007. Phytochemical screening and antibacterial

Properties of organic solvent fractions of Psidiumguajava aqueous leaf extracts. International Journal of Pharmacology. 3.

Marquina, V., L. Araujo, J. Ruiz, A. Rodriguez-Malaver and P. Vit. 2008. Composition and anti-oxidant properties of guava (*Psidiumguajava*L.) fruit pulp and jam. Archivoslatinoamericanous de nutrition. 58:98-102.

Nwinyi, O. C., S. Chinedu and O. Ajani. 2008. Evaluation of antibacterial activity of

Psidiumguajava and Gongronemalatifolium. J. Med. Plants. Res. 2:189-192.

Rahman, Z., M.N. Siddiqui, M. Khatun and M. Kamruzzaman. 2013. Effect of guava (*Psidiumguajava*) leaf meal on production performance and anti-microbial sensitivity in broiler. J Nat Prod. 6:177-87.

Ramadan, M.M., K.F. El-Massry, A.H. El-Ghorab and A.R.H. Farag. 2009. Investigation of Chemical composition, anti-oxidant activity, and hypoglycemic effect of Egyptian guava leave volatiles. JASMR. 4:137-148.

Williams, P. 2001. The use of essential oils and their compounds in poultry nutrition. World poultry. 17:14-15.

Kaileh, M.; W.V. Berghe; E. Boone; T. Essawi and G. Haegeman (2007). Screening of indigenous Palestinian medicinal plants for potential anti-inflammatory and cytotoxic activity. J. Ethnopharmacol, 113(3): 510-516.

Ljubojević, D., Puvača, N., Pelić, M., Todorović, D., Pajić, M., Milanov, D. &Velhner, M. 2016. "Epidemiological significance of poultry litter for spreading the antibiotic-resistantstrains of Escherichia coli". World's Poultry Science Journal, 72(3): 485-494, ISSN: 0043-9339.

FAO (Organization de lasNacionesUnidad para la Alimentación y la Agricultura). 2016. El plan de acción de la FAO sobre la resistencia a los antimicrobianos 2016-2020. Ed. FAO. Roma, Italia, pp. 1-17, ISBN: 978-92-5-309392-2.

El- Deek, A., M. Asar, S. Hamdy and A. Abdalla. 2009. Utilization of guava by products in broiler finisher diets. Egypt. Poult. Sci. J. 29:53-79.

Porwal, V., P. Singh and D. Gurjar. 2012. A comprehensive study on different methods of extraction from guajava leaf leaves for curing various health problems. IJERA.2:490-496.

Manan, N., S. Safdar, and M. Javed. 2013. Socio-economic determinates of population growth: a case study of Pakistan. Issues 1:32–38.

Richard, F.T.; Joshua, A.T. and Philips, A.J. (2013). Effect of aqueous extract of leaf and bark of guava (Psidiumguajava) on fungi Microsporumgypseum and Trichophytonmentagrophytes, and bacteria Staphylococcus aureus and Staphylococcus epidermidis. Advancement in Medicinal Plant Research, 1(2): 45-48.