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Effect of supplementation of soybean oil and guava (*Psidium guajava*) leaf powder on growth performance, nutrient utilization, carcass traits and haemato-biochemical parameters in broiler chickens

Anju Sati, BC Mondal, Ashoka Kumar and Anil Kumar

Abstract
A feeding trial was conducted to discern the effect of dietary incorporation of soybean oil and guava leaf powder on performance, nutrient utilization, carcass traits, haemato-biochemical parameters of broiler chickens. The result showed the significant increase in weight gain of broiler chickens fed combination of guava leaf powder and soybean oil than the other groups. Final body weight was maximum in the treatment group fed 1% guava leaf powder and 3% soybean oil (1825.65 g) followed by treatment group fed 1% guava leaf powder (1801.70 g), treatment group fed 3% soybean oil (1780.82 g) and 1760.30 g in control group. Incorporation of soybean oil and guava leaf powder did not affect nutrient utilization and caused a significant decrease ($P \leq 0.05$) in ether extract content of breast and thigh muscles. There was significant increase ($P \leq 0.05$) in the haemoglobin, packed cell volume, total protein and globulin content in the broiler chickens fed guava leaf powder as supplement. Significant decrease ($P \leq 0.05$) in serum cholesterol, triglycerides, blood glucose and liver enzymes in the broilers fed guava leaf powder as compared to other groups. The results of present study suggest that guava leaf powder supplementation alone or with soybean oil in the basal diet has beneficial effects in the broilers as it increases growth rate, serum total protein and globulin content whereas it reduces serum cholesterol, triglycerides, glucose and liver enzymes such as SGOT and SGPT.

Keywords: Guava leaf powder, soybean oil, broiler, performance

1. Introduction
Plants and its products are used extensively in many Asian, African and other countries. They are the valuable alternative for growth with no residual toxicity. Recently a great attention has been given to plant extracts to be fed to poultry as feed additives to improve and increase production. A number of dietary herbs, plant extract and essential oil are not only use for its nutritive value but also it has therapeutic and prophylactic property. Some foliages have been known to contain a range of bioactive compounds that are beneficial for chicken's health (Rao *et al*., 2019) [26]. These are vitamins, phenolic acids, flavonoids, isothiocyanates, tannins and saponins.

Guava (*Psidium guajava*) belongs to phylum Magnoliophyta, class Magnoliopsida and family Myrtaceae, originated in Maxico (Rios *et al*., 1997) [28]. The literature survey found that guava has numerous medicinal properties recorded worldwide in the form of ethnobotanical/ ethnopharmacological studies, laboratory work and clinical trials. Guava leaf has anti inflammatory, analgesic, antimicrobial, hepatoprotective, and antioxidant properties. Guava leaf was also shown to have antiviral effects (Guo *et al*., 2009) [9]. Phytochemical examination of the leaf revealed the presence of flavonoids, tannins, saponins, phenols, lectins, triterpenes and carotenoids (Geidam, *et al*., 2007) [8]. In poultry production the use of vegetable oils and animal fats has been beneficial in broiler diet. They have higher than expected biological value which increases its metabolizable dietary energy result in higher growth rates and better feeding efficiency. Soybean oil, the most popular oil feedstocks used in broiler chicken diets, can improve performance and local immune systems in the broiler's small intestine (Liang *et al*., 2015) [16].

Presently there is very less information available about feeding guava leaf and soybean oil in the broiler chicken diet.

Though both of these feed additives have been fed separately in various experiments, but information about combined feeding of these feed additives and/or feed ingredients is not available. Therefore the objective of the present study was to investigate the effect of guava leaf and soybean oil supplementation on feed intake, growth performance, nutrient utilization, carcass characteristics and haemato-biochemical constituents in broiler chickens.

2. Material and methods

A total of 120, day-old broiler chicks were procured and randomly divided into four treatment groups with three replications having ten chicks in each in a completely randomized design.

First group was given basal diet while second, third and forth groups fed basal diet supplemented with 1% guava leaf powder, 3% soybean oil and mixture of 1% guava leaf powder plus 3% soybean oil, respectively. The feeding trial lasted for 42 days *viz*., 0-21 days (starter phase) and 21-42 days (finisher phase). The ingredient composition of diets is presented in Table 1.

2.1 Procurement of guava (Psidium guajava) leaf and soybean oil

Guava (*Psidium guajava*) leaves were collected from Pantnagar and adjoining areas. These leaves were shade dried to avoid nutrient loss and ground to powder by an electric feed grinder.

Soybean oil was procured from local market. Soybean oil and guava (*Psidium guajava*) leaf powder was supplemented in broiler chicken diet.

2.2 Growth performance parameters

Daily record of feed offered to birds of different treatment groups was maintained. The birds from each replicate were weighed individually at weekly basis. The body weight gain, feed conversion ratio and performance index were calculated.

2.3 Analysis of feed, meat and excreta samples

The representative samples of experimental broiler starter and finisher feeds as well as excreta obtained during metabolism trial and representative meat samples from breast and thigh were collected and proximate analysis was conducted on the samples collected, using the standard principles (AOAC, 2000) [4].

2.4 Blood collection and analysis

Blood samples were collected at the end of feeding trial (42nd day). Blood sample (about 3.0 ml) was collected aseptically from the wing vein with sterile needle into well labelled blood collecting test tubes.

2.5 Haematological parameters

Haemoglobin concentration (g/dl) was estimated following the method described by Sharma and Singh (2000) [33] using Sahli's haemoglobinometer with acid haematin method. Micro haematocrit method was used to estimate PCV as described by Sharma and Singh (2000) [33]. Total erythrocyte counts (TEC) and total leucocytes count (TLC) was performed with Neubauer's counting chamber as described by Jain (1986) [11]. Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) was calculated using formulae.

2.6 Serum biochemical parameters

Cholesterol concentration in serum was estimated spectrophotometrically using Erba diagnostic kit with Enzymatic CHOD-PAP (cholesterol oxidase - phenol + amino phenazone) method at 505 nm wavelength (Tietz, 1998) [36]. Serum triglycerides were estimated using Autospan diagnostic kit based on the method of Wako and the modifications by McGowan *et al*. (1983) [18] at 505 nm wavelengths. Estimation of serum glucose was conducted by enzymatic GOD-POD (glucose oxidase- peroxidase) method with using Autospan diagnostic kit at 505 nm wavelength against blank reagent (Sacks, 1998) [30]. Total protein concentration in serum was estimated by biuret method using Erba diagnostic kit at 540 nm wavelength (Johnson *et al*., 1999) [13]. Albumin concentration in the serum was estimated by bromocresol green end point assay method with the aid of AUTOSPAN diagnostic kit at 630 nm wavelength (Johnson *et al*., 1999) [13]. The serum albumin content was subtracted from serum total protein content to arrive at serum globulin content. For the estimation of serum glutamate pyruvate transaminase (SGPT), 4 - DNPH method (2, 4-Dinitrophenylhydrazin) of Reitman and Frankel (1957) [27] was followed using AUTOSPAN diagnostic kit. The activity of serum glutamate oxaloacetate transaminase (SGOT) or aspartate aminotransferase (AST) was measured following 2, 4 - DNPH method of Reitman and Frankel (1957) [27] using a AUTOSPAN diagnostic kit. The alkaline phosphatase activity in serum was assayed using Autospan diagnostic kit (Bergmeyer *et al*., 1986) [5].

2.7 Carcass traits

For the carcass trait studies, two representative broiler chickens from each replicate of all treatment groups was sacrificed at the end of feeding cum growth trial for evaluation of carcass characteristics.

2.8 Statistical analysis

The experimental data obtained in the present study were analysed statistically (Snedecor and Cochran, 1994) [34] by using general linear model procedure. Difference between treatment means were compared using Duncan's multiple range test (Kramer, 1957) [14].

3. Result and discussion

3.1 Growth performance

Growth performance of broiler chicks fed the experimental diets is shown in table 2, 3 and 4. During the starter phase, incorporation of soybean oil and guava leaf powder in the diet of broiler chicks influenced the body weight and body weight gain but did not influence feed intake, feed conversion ratio and performance index. During the finisher phase, incorporation of soybean oil and guava leaf powder in the diet of broiler chicks influenced the body weight, body weight gain and performance index but did not show significant effect on feed intake and feed conversion ratio. There was no significant difference in feed intake among different groups but the feed intake was higher in the treatment groups fed diet supplemented with guava leaf powder alone or with guava leaf powder plus soybean oil along with basal diet. The result showed significant ($P \leq 0.05$) increased final body weight, weight gain and performance index in the group supplemented with guava leaf powder and soybean oil. The average body weight gain of broiler chickens during whole feeding trial was 1711.60, 1753.04, 1731.82 and 1776.85 g in

treatment groups T1, T2, T3 and T4, respectively. The overall cumulative performance in broiler chickens in terms of weight gain and performance index was significantly higher in T4 group which were fed 1 percent of guava leaf powder and 3 percent soybean oil followed by T2 where the diet of broiler chicken was supplemented with 1 percent of guava leaf powder.

The present findings are in agreement with that of Mahmoud *et al.* (2013) [19] who reported that dietary incorporation of one percent dried guava leaves in diets had a significant improvement on body weight, weight gain, feed conversion ratio and health status but had no effect on feed consumption of broiler chicks. Srivastava *et al.* (2013) [35] reported the significant difference in the body weight gain and performance efficiency of broilers fed herbal based diets. Olusola and Olorunfemi (2017) [23] observed that the addition of guava leaves had enhanced mean weight gain in the fish fingerlings.

The study carried out by Scafie *et al.* (1994) [32] reported that body weight of broiler chickens was significantly higher in the group which was fed soybean oil as a source of lipids. Franco *et al.* (1996) [7] studied the effect of addition of soybean oil in the broiler chicken diet and observed that addition of soybean oil improves the live weight gain significantly (P≤0.05) of 22-49 day aged broilers.

3.2 Nutrient utilization

Feeding broilers on diet supplemented with soybean oil and guava leaf had no significant affect on nutrient utilization as shown in table 5. The result are in agreement with the findings of Llorens *et al.* (2007) [17] who reported that there was no significant difference on nutrient utilization due to supplementation of soybean oil concentration in gilthead sea bream. On the contrary, Omitoyin *et al.* (2019) [24] reported the improved nutrient utilization of *Oreochormis niloticus* in feeding guava leaf extract.

3.3 Carcass characteristics

Average dressing percentage with or without giblet, cut-up parts, organ weights and processing losses of broiler chickens of different treatment groups was not significantly differ due to supplementation of soybean oil and guava leaf powder in the diets as shown in table 6.

These results are in agreement with Al-Kassie and Witwit (2010) [2] and Al-Kassie *et al.* (2012) [3] who reported that the use of herbal plant had no effect on dressing percentage, gizzard and heart weight.

3.4 Meat composition

Dietary supplementation of soybean oil and guava leaf powder significantly (P≤0.05) decrease the ether extract content of both breast and thigh muscles as shown in table 7. Significantly (P≤0.05) lower ether extract content was found in T2 group which were fed one percent of guava leaf powder and T4 group fed 1% guava leaf powder and 3% soybean oil. This result agreed with the findings of Mahmoud *et al*. (2013) [19] who indicated that dietary supplementation of dried guava leaves significantly (P≤0.05) decreased the breast ether extract content.

3.5 Haematological parameters

Dietary supplementation of soybean oil and guava leaf powder on haemoglobin, packed cell volume, total erythrocyte count, mean corpuscular volume and mean corpuscular haemoglobin showed significant changes (P≤0.05) as shown in table 8. Total leukocyte counts and mean corpuscular haemoglobin concentration was not significantly changed. This is in agreement with Adeyemi *et al.* (2010) [1] who revealed that haemoglobin content, packed cell volume and mean corpuscular volume significantly increased in supplementing guava leaf ethanolic extract to the rats. Salahuddin *et al.* (2013) [31] and Islam *et al.* (2018) [10] reported that there was an increase in total erythrocytes count on supplementing soybean oil to the Swiss albino mice. Kullu *et al.* (2013) [15] reported that supplementation of guava leaf significantly increase the mean corpuscular volume and mean corpuscular haemoglobin in the rats.

3.6 Serum biochemical parameters

There was significant (P≤0.05) change in the serum cholesterol, triglycerides, glucose, serum glutamate pyruvate transaminase (SGPT), serum glutamate oxaloacetate transaminase (SGOT), total protein and globulin content on supplementation of soybean oil and guava leaf powder in the broiler chickens as shown in table 9. The mean serum cholesterol concentration in the broilers was 138.31, 109.79, 146.99 and 126.77 mg/dl in treatment groups T1, T2, T3 and T4 respectively. The significant (P≤0.05) decrease in serum cholesterol concentration (mg/dl) was observed in T2 group (fed diet supplemented with 1% guava leaf powder) and T4 group (fed diet supplemented with 1% guava leaf powder and soybean oil) as compared to T1 group (fed basal diet) and T3 group (fed 3% soybean oil). Alkaline phosphatase and albumin content was not significantly affected. The present findings are in agreement with Crespo and Esteve-Garcia (2002) [6] who reported that there was significant decrease in the cholesterol on supplementing guava leaf extract in the broiler chickens. Prince *et al*. (1987) [25] suggested that the hypocholesterolemic property of guava is due to presence of saponins. Salahuddin *et al.* (2013) [31] reported that there was substantial increase in the total cholesterol on administrating soybean oil in the diet of Swiss albino mice. Kullu *et al.* (2013) [15] and Morsy *et al.* (2019) [20] reported the reduction the serum triglyceride value on supplementation of guava leaf extract in rabbits. Ogueri *et al*. (2014) [21] and Jayachandran *et al.* (2018) [12] also found the similar result of decrease in blood glucose level in the rats supplemented with guava leaf extract. Tannins, flavonoids, pentacyclic triterpenoids, guiajaverin, quercetin and other chemical compounds present in the guava plant account for hypoglycemic property (Ojewole, 2005; Wang *et al.*, 2005) [22, 38]. Mahmoud *et al.* (2013) [19] found the significant (*P*<0.05) increase in total protein and serum globulin on addition of guava leaf and olive oil in the broiler chickens. Rodrigues *et al.* (2019) [29] reported no significant difference in the serum albumin concentration on supplementation of soybean oil to dairy cows. Udem *et al.* (2011) [37] reported the significant decrease in the SGOT and SGPT values in the mice which were supplied guava leaf extract.

Table 1: Ingredient composition (%) of broiler chicks (starter and finisher) basal diets (kg/100kg)

Ingredients	Broiler Starter (0-3weeks)	Broiler Finisher (3-6weeks)
Yellow maize	53.725	58.325
De-oiled rice polish	04.00	06.00
De-oiled soybean meal	30.00	25.00
Groundnut cake-solvent extracted	10.00	08.00
Di-calcium phosphate	01.00	01.40
Lysine	00.20	00.20
DL-methionine	00.30	00.30
Choline chloride	00.05	00.05
Hepatocare	00.10	00.10
Common salt	00.30	00.30
Mineral mixture	00.25	00.25
Vitamin premix	00.025	00.025
Coccidiostat	00.05	00.05
Total	100.000	100.000

Table 2: Average growth performance of broiler chickens from 0-21 days of age fed diets incorporated with soybean oil and guava (*Psidium guajava*) leaf powder

Parameters	Treatment/Groups			
	T_1(Basal diet)	T_2(Basal diet+ 1% guava leaf)	T_3 (Basal diet+ 3% soybean oil)	T_4(Basal diet+ 1% guava leaf + 3% soybean oil)
Initial body weight (g)	48.70±1.41	48.67±1.39	49.00±0.31	48.80±0.10
Body weight at 21st day (g)*	500.97±5.18^b	523.37±2.43^a	519.20±7.45^a	529.40±3.71^a
Weight gain (g)*	452.27±1.59^b	474.70±2.35^a	470.20±7.00^a	480.60±3.75^a
Feed intake (g)	829.70±15.55	853.78±12.31	844.90±11.76	868.90±17.02
Feed conversion ratio	1.84±0.03	1.80±0.00	1.80±0.02	1.81±0.02
Performance index	246.92±1.45	264.08±3.63	263.63±9.96	266.71±11.30

a and b mean values bearing different superscripts in a row differ significantly, *(P≤0.05)

Table 3: Average growth performance of broiler chickens from 21-42 days of age fed diets incorporated with soybean oil and guava (*Psidium guajava*) leaf powder

Parameters	Treatment/Groups			
	T_1(Basal diet)	T_2(Basal diet+ 1% guava leaf)	T_3(Basal diet+ 3% soybean oil)	T_4(Basal diet+ 1% guava leaf + 3% soybean oil)
Body weight at 21st day (g)*	500.97±5.18^b	523.37±2.43^a	519.20±7.45^a	529.40±3.71^a
Body weight at 42nd day (g)*	1760.30±9.02^b	1801.70±4.62^{ab}	1780.82±13.76^b	1825.65±2.86^a
Weight gain (g)*	1259.33±1.57^c	1278.34±5.30^b	1261.62±2.67^c	1296.25±2.53^a
Feed intake (g)	2631.40±39.17	2658.97±25.79	2634.10±13.40	2692.80±8.72
Feed conversion ratio	2.09±0.05	2.08±0.04	2.09±0.02	2.08±0.04
Performance index*	603.32±2.66^c	615.42±2.15^b	604.56±1.83^c	624.56±2.30^a

a, b and c mean values bearing different superscripts in a row differ significantly, *(P≤0.05)

Table 4: Average growth performance of broiler chickens from 0-42 days of age fed diets incorporated with soybean oil and guava (*Psidium guajava*) leaf powder

Parameters	Treatment/Groups			
	T_1(Basal diet)	T_2(Basal diet+ 1% guava leaf)	T_3(Basal diet+ 3% soybean oil)	T_4(Basal diet+ 1% guava leaf + 3% soybean oil)
Initial body weight (g)	48.70±1.41	48.67±1.39	49.00±0.31	48.80±0.10
Body weight at 42nd day (g)*	1760.30±9.02^b	1801.70±4.62^{ab}	1780.82±13.76^b	1825.65±2.86^a
Weight gain (g)*	1711.60±9.89^b	1753.04±4.85^{ab}	1731.82±14.06^b	1776.85±2.84^a
Feed intake (g)	3461.10±56.38	3512.75±75.14	3479.00±101.82	3561.70±58.82
Feed conversion ratio	2.02±0.02	2.00±0.06	2.01±0.00	2.00±0.01
Performance index*	847.43±7.26^b	875.28±0.99^{ab}	862.13±7.16^b	886.57±7.57^a

Table 5: Average value of nutrient utilization (%) in broiler chickens fed diets incorporated with soybean oil and guava (*Psidium guajava*) leaf powder

Parameters	Treatment/Groups			
	T_1(Basal diet)	T_2(Basal diet+ 1% guava leaf)	T_3(Basal diet+ 3% soybean oil)	T_4 (Basal diet+ 1% guava leaf + 3% soybean oil)
Dry matter	71.36±0.56	70.22±1.33	70.57±0.42	71.23±1.03
Organic matter	77.45±0.89	78.13±0.73	78.76±0.98	77.56±1.53
Crude protein	77.57±0.89	77.56±1.03	78.43±1.95	77.45±1.68
Ether extract	72.66±0.62	73.55±1.54	71.45±0.92	72.47±1.69

Table 6: Average values for dressing percentage, cut-up parts, organ weights and processing losses of finisher broilers chickens (%live weight) fed diets incorporated with soybean oil and guava (*Psidium guajava*) leaf powder

Parameters	Treatment/Groups			
	T_1(Basal diet)	T_2(Basal diet+ 1% guava leaf)	T_3(Basal diet+ 3% soybean oil)	T_4(Basal diet+ 1% guava leaf + 3% soybean oil)
Dressing percentage without giblet (%)	62.55±0.71	61.15±0.75	61.62±1.29	61.13±0.36
Dressing percentage with giblet (%)	71.85±0.62	69.94±0.72	70.55±1.17	69.72±0.33
Neck	3.17±0.15	3.16±0.10	3.11±0.24	3.02±0.14
Wing	6.56±0.04	6.61±0.24	6.97±0.39	6.73±0.20
Back	10.46±0.23	10.13±0.21	9.75±0.15	9.82±0.14
Breast	19.90±0.75	18.89±0.55	18.93±0.43	17.93±0.09
Thigh	9.53±0.15	9.18±0.22	9.38±0.20	8.87±0.33
Heart	0.59±0.01	0.58±0.02	0.62±0.04	0.59±0.01
Liver	2.70±0.15	2.39±0.17	2.54±0.15	2.48±0.07
Blood	3.77±0.04	3.52±0.08	3.60±0.18	3.42±0.21
Abdominal fat	1.56±0.09	1.60±0.05	1.54±0.03	1.45±0.04

Table 7: Average values of meat composition (on% DM basis) of broiler chickens fed diets incorporated with soybean oil and guava (*Psidium guajava*) leaf powder

Parameters	Treatment/Groups			
	T_1(Basal diet)	T_2(Basal diet+ 1% guava leaf)	T_3(Basal diet+ 3% soybean oil)	T_4(Basal diet+ 1% guava leaf + 3% soybean oil)
Breast muscle				
Crude protein	82.25±1.00	81.26±1.67	81.38±1.95	81.78±2.30
Ether extract*	11.08±0.06^a	9.17±0.08^c	11.17±0.11^a	9.83±0.30^b
Ash	5.27±0.43	5.23±0.32	5.17±0.32	5.20±0.31
Thigh muscle				
Crude protein	73.19±0.18	72.08±0.79	73.73±1.05	73.32±1.79
Ether extract*	19.42±0.68^a	16.42±0.30^b	19.08±0.65^a	17.92±0.22^{ab}
Ash	4.33±0.27	4.27±0.23	4.17±0.43	4.20±0.31

a, b and c mean values bearing different superscripts in a row differ significantly, *(P≤0.05)

Table 8: Haematological values of broiler chickens fed diets supplemented with soybean oil and guava (*Psidium guajava*) leaf powder (42nd days)

Parameters	Treatment/Groups			
	T_1(Basal diet)	T_2(Basal diet+ 1% guava leaf)	T_3(Basal diet+ 3% soybean oil)	T_4(Basal diet+ 1% guava leaf + 3% soybean oil)
Haemoglobin (%)*	9.09±0.04^b	9.70±0.05^a	9.65±0.04^a	9.61±0.04^a
Packed cell volume (%)*	26.04±0.22^b	28.05±0.15^a	26.42±0.21^b	27.72±0.24^a
Total erythrocyte counts (10^6 /µl)*	2.36±0.02^b	2.39±0.04^b	2.57±0.06^a	2.56±0.01^a
Total leukocyte counts (10^3 /µl)	26.50±1.16	27.35±0.34	26.83±0.54	26.70±0.89
Mean corpuscular volume (fl)*	110.92±0.67^b	117.89±0.56^a	103.50±0.97^c	109.18±0.56^b
Mean corpuscular haemoglobin (pg)*	38.65±1.08^{ab}	40.80±0.44^a	37.74±0.61^b	37.80±0.44^b
Mean corpuscular haemoglobin concentration (g/dl)	35.05±2.26	34.64±0.83	36.63±1.00	34.68±1.21

a, b and c mean values bearing different superscripts in a row differ significantly, *(P≤0.05)

Table 9: Average values of serum biochemical constituents of broilers fed diets incorporated with soybean oil and guava (*Psidium guajava*) leaf powder (42nd days)

Parameters	Treatment/Groups			
	T_1(Basal diet)	T_2(Basal diet+ 1% guava leaf)	T_3(Basal diet+ 3% soybean oil)	T_4(Basal diet+ 1% guava leaf + 3% soybean oil)
Cholesterol (mg/dl)*	138.31±1.30^a	109.79±5.33^c	146.99±3.11^a	126.77±3.34^b
Triglyceride (mg/dl)*	84.56±1.35^b	75.75±3.67^c	91.97±3.21^a	77.46±1.54^c
Glucose (mg/dl)*	156.32±3.43^a	144.83±1.58^b	156.70±0.75^a	143.77±1.38^b
SGOT(U/L) *	126.41±0.75^a	111.68±0.67^c	127.59±1.55^a	116.69±2.34^b
SGPT(U/L) *	24.46±0.44^a	19.15±0.41^b	23.28±0.52^a	20.92±0.98^b
Alkaline phosphatase (U/L)	85.88±2.39	84.98±13.48	84.07±12.60	84.98±11.62
Total Protein (g/dl)*	3.20±0.10^b	4.19±0.21^a	3.38±0.10^b	4.02±0.17^a
Albumin (g/dl)	1.44±0.04	1.46±0.09	1.41±0.03	1.53±0.05
Globulin (g/dl)*	1.76±0.14^b	2.73±0.18^a	1.98±0.07^b	2.49±0.21^{ab}

4. Conclusion

It could be concluded that guava leaf powder supplementation alone or with soybean oil in the basal diet has beneficial effects in the broilers as it increases growth rate, serum total protein and globulin content whereas it reduce serum cholesterol, triglycerides, glucose and liver enzymes such as SGOT and SGPT.

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