

EFFECT OF FEEDING TURMERIC AND AMLA ON GROWTH PERFORMANCE OF BROILERS

by

Mr. Gyan Chandra

(Reg. No. 15/134)

A thesis submitted to the
**MAHATMA PHULE KRISHI VIDYAPEETH,
RAHURI-413 722, DIST- AHMEDNAGAR,
MAHARASHTRA, INDIA**

In partial fulfillment of the requirement for the degree
of
MASTER OF SCIENCE (AGRICULTURE)
in
ANIMAL HUSBANDRY



**DIVISION OF ANIMAL HUSBANDRY AND DAIRY SCIENCE
COLLEGE OF AGRICULTURE, PUNE - 411005
MAHATMA PHULE KRISHI VIDYAPEETH,
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APPROVED BY

Dr. S. H. Mane

(Chairman and Research Guide)

Dr. S. A. Dhage
(Committee Member)

Dr. Y. G. Fulpagare
(Committee Member)

Prof. B .K. Pawar
(Committee Member)

Dr. D. P. Kaledhonkar
(Committee Member)

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MAHATMA PHULE KRISHI VIDYAPEETH,

RAHURI- 413 722, DIST- AHMEDNAGAR

MAHARASHTRA, INDIA

2018

CANDIDATE'S DECLARATION

I hereby declare that this thesis or part
there of has not been submitted
by me or other person to any
other University or Institute
for a Degree or
Diploma

Place: Pune

Date : / /2018

(GYAN CHANDRA)

Dr. S. H. Mane

M.Sc. (Agri.) Ph.D.,

Assistant Professor,

Animal Husbandry and Dairy Science,

College of Agriculture, Pune-05

CERTIFICATE

This is to certify that the thesis entitled, “**EFFECT OF FEEDING TURMERIC AND AMLA ON GROWTH PERFORMANCE OF BROILERS,**” submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) in partial fulfilment of the requirement for award of the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **ANIMAL HUSBANDRY**, embodies the results of a piece of bona-fide research work carried out by **MR. GYAN CHANDRA** under my guidance and supervision and that no part of the thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of this investigation have been duly acknowledged.

Place: Pune

Date: / / 2018

(Dr. S. H. Mane)

Research Guide

Prof. B.K. Pawar,
Head of Department,
Animal Husbandry and Dairy Science,
College of Agriculture, Pune-05

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Place: Pune

Date: / / 2018

(Prof. B.K. Pawar)

Dr. P.N. Rasal,
Associate Dean,
College of Agriculture,
Pune-411 005
Maharashtra (India)

CERTIFICATE

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Place: Pune

Date: / / 2018

(Dr. P.N. Rasal)

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LIST OF ABBREVIATIONS

%	-	Per cent
/	-	Per
@	-	At the rate of
Adlib	-	Adlibitum
°C	-	Degree Celsius
CD	-	Critical difference
d.f.	-	Degrees of freedom
Ed.	-	Edition
Kg	-	Kilogram
<i>et al.</i>	-	And others
Etc	-	etcetera (and other things)
Fig.	-	Figure
gm	-	Gram
Hrs	-	Hour(s)
<i>i.e.</i>	-	id est (that is)
SE	-	Standard error
SE(m)	-	Standard error of mean
Sig.	-	Significant
NS	-	Non significant
J.	-	Journal
Sci.	-	Science
<i>viz.,</i>	-	Namely
No.	-	Number
Rs.	-	Rupees
Lit	-	Liter
SO	-	Soybean oil
AP	-	Amla Powder
IBD	-	Infectious bursal disease
FCR	-	Feed Conversion Ratio
TP	-	Turmeric Powder

ABSTRACT

“EFFECT OF FEEDING TURMERIC AND AMLA ON GROWTH PERFORMANCE OF BROILERS”

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College of Agriculture, Pune – 411 005

2018

Research Guide	: Dr. S. H. Mane
Department	: Animal Husbandry and Dairy Science

The present investigation entitled “Effect of feeding turmeric and amla on growth performance of broilers” was carried out to assess the effect on body weights, body weight gain, feed intake, feed conversion ratio (FCR), dressing percentage and meat bone ratio of broiler poultry production.

Seventy, day old commercial broiler chicks were purchased from Vankateshwara hatchery, Pune, Maharashtra. They were randomly distributed into 7 treatment groups viz. T₀, T₁, T₂, T₃, T₄, T₅ and T₆ with 10 chicks in each group.

Turmeric and amla powder was added in experimental ration at different levels. The dietary treatments consisted of one basal control (T₀), supplemented with 0.25% turmeric in treatment (T₁), 0.5% turmeric in treatment (T₂), 0.25% amla in treatment (T₃), 0.5% amla in treatment (T₄) and 0.25% (T₅), 0.5% (T₆) turmeric and amla with combination, respectively.

The experiment was continued upto 6 weeks. The overall mortality in Vencobb-400 poultry birds of various groups during the experimental period was zero per cent.

The corresponding average live body weights at the end of 6th week of age for T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 2595.00, 2707.90, 2762.90, 2776.30, 2858.40, 2895.90 and 2930.00g, respectively. The treatment T₆ was statistically significantly (P<0.01) superior over other treatments. The average weekly body weight gains at the sixth week of age for T₀, T₁, T₂, T₃, T₄, T₅ and T₆ groups were 502.80, 540.40, 510.20, 554.90, 553.50, 560.50 and 589.10g, respectively. The treatment T₆ was statistically significantly superior over other groups.

The average overall feed intake recorded at the end of 6th week of age were 4215.05, 4180.15, 4175.70, 4184.05, 4189.85, 4199.75 and 4172.95g in T₀, T₁, T₂, T₃, T₄, T₅ and T₆ treatment

groups, respectively. Higher feed intake was observed in T₀ (4215.05g) and lower feed intake was observed in T₆ (4172.95g). The treatment T₆ was significantly ($P<0.01$) superior over other treatment groups.

The average overall feed conversion ratio (FCR) at the end of 6th week of age for T₀, T₁, T₂, T₃, T₄, T₅ and T₆ groups were 1.55, 1.48, 1.45, 1.46, 1.41, 1.40 and 1.36g, respectively. Statistically significantly ($P<0.01$) higher FCR was observed in treatment T₆ (1.36) and lower in treatment T₀ (1.55).

The average dressing percentage of T₀, T₁, T₂, T₃, T₄, T₅ and T₆ was 65.81, 67.55, 68.02, 68.93, 66.71, 69.15 and 72.20g, respectively. Significantly higher dressing percentage was observed in T₆ (72.20 %) followed by T₅, T₃, T₂, T₁, T₄ and T₀ treatments.

The meat bone ratio of T₀, T₁, T₂, T₃, T₄, T₅, and T₆ was 13.35, 14.19, 14.35, 13.28, 13.42, 14.29 and 14.36g, respectively. Lower meat bone ratio was observed in T₃ (13.28) which was statistically significant.

Economical data of experiment shows that, the average feed consumption of birds 4.23, 4.18, 4.18, 4.19, 4.19, 4.20 and 4.18 kg respectively in T₀, T₁, T₂, T₃, T₄, T₅ and T₆ treatment groups. It showed that higher feed was consumed by T₀ group than others. Similarly there were higher body weights at the end of sixth week also observed in T₆ (2.93 Kg.) and T₅ (2.89 kg.) groups than other. Finally higher net profit was recorded in T₆ (54.74Rs./bird) and T₅ (Rs. 54.51/bird) as compared to other treatment groups.

It is therefore concluded that supplementation of turmeric and amla in combination to basal ration at the rate of 0.5% was beneficial in broilers to improve feed conversion ratio (FCR), dressing percentage and meat bone ratio.

1. INTRODUCTION



1.1. Background Information

The term poultry is used collectively to designate those species of birds that have been domesticated to reproduce and grow in captivity and render product of economic value, such as meat, egg, manure and animal feed. Poultry enterprises, when compared with other livestock ventures, are easy and economical to establish. Within 7 weeks of hatching, 1.8 kg broiler can be produced for meat supply. Egg can be produced in a little period as six month. Broilers require a high protein ration and utilize some feeds which could be used for human beings.

As a primary source of animal protein, the poultry sector offers a valuable repository to bridge the gap between demand and the availability of balanced nutrition. Poultry production, particularly broiler production is the quickest way to increase the availability of high quality protein for human consumption. Since the feed cost alone contributes to about 70-75% of the total cost of production, economically poultry production is, therefore, possible only when the feed cost is reduced & efficiency of feed utilization is increased (Pervez *et al.* 2011).

The products of the poultry industry provide high quality human food. Poultry meat and eggs are important as protective food in human nutrition. Chicken is one of the most palatable of all meats and is easily digestible. The poultry sector provides livelihood to nearly one lakh farmers, direct and indirect employment to about 1.5 million persons and contributes Rs. 7,500 crore to the national income.

Indian poultry industry opportunities are unlimited because India has population of approximately 1.25 billion people with GDP growth rate of about 9% which is one of the biggest consumer market in the world. India's livestock population is highest among the world. The livestock sector contributes approximately 4% to GDP and 27% to agricultural GDP. Poultry contributes about 15% of total food energy and 5% of dietary protein.

In addition to providing nutritional security to the poor, it offers direct and indirect employment over 1.5 million people and have been one of the key contributors within the livestock sector. The market size for Poultry Industry is estimated at around USD 7.9 billion (INR 350 billion) and is growing at an attractive rate of 12%-15% annually. India is 3rd largest producer of eggs with annual production of 57 billion eggs & 5th largest producer of poultry meat with a production of 2.5 million tone of poultry meat per annum. Annual per capita consumption in India is only 52 eggs and 2.5 kg of poultry meat, which is below to the levels recommended by the Nutritional Advisory Committee– 180 eggs and 10.8 kg of poultry meat. Poultry products

account for more than 75% of the non- vegetarian items consumed in India. Industry growth rate of 12%-15% compared to a National GDP growth rate of 9%.

Table 1. India's poultry meat consumption

	2011	2012	2013	2014	2015	2016	2017
Per capita (kg)	2.0	2.1	2.2	2.3	2.8	3.1	3.6
Total in kilotons	2,889.6	3,062.1	3,154.7	3,246.8	3892.0	4194.0	4490.0

(USDA, 2017)

Poultry is the major source of meat now a days in India. Its share in total meat consumption is 28 percent, as against 14 percent 10 to 28 years ago. It has outpaced its two competitors – beef or veal and buffalo meat. High mutton prices, religious restrictions on beef, pork and the limited availability of fish outside coastal regions have all helped to make poultry meat the most preferred and most consumed meat in India (Rao and Nambiar 2015).

The broiler sector has been the most dynamic sector of poultry production due to its marginal investments and quick returns. Broilers are very fast growing birds because of fast growth rate, the birds undergo heavy metabolic stress. To release the stress, some sort of antioxidants are required, being these antioxidants prevents cellular damage. Some of the dietary plant sources have antioxidants such as carotenoids, phenolic acids and flavonoids.

1.2. Importance and Need of Study

The medicinal plant turmeric (*Curcuma longa*) is commonly used as a spice in human food. The plant grows to a height of three to five feet and has oblong pointed leaves with bear's funnel-shaped yellow flowers. Turmeric has been used in Ayurvedic medicine and traditional Asian and African systems of medicine. Turmeric is found to have antifungal property as well as it is effective in treating liver obstruction and dropsy, wounds, inflammatory troubles of joints. Current traditional Asian doctors use turmeric against biliary disorders, anorexia, coryza, cough, diabetic wounds, and also turmeric has been used internally as a stomachic, tonic and blood purifier. Turmeric supplementation has been also reported to improve the body weight gain and feed consumption of broiler chicken. (Osawa *et al.*, 1995).

Therapeutic properties of turmeric includes anti-oxidant, anti-diabetic, antibacterial, antifungal, antiprotozoal, antiviral and hypocholesteremic activities (Ahmadi, 2010).

Amla (*Phyllanthus emblica*, syn. *Emblica officinalis*), the Indian gooseberry or amla, is a deciduous tree of phyllanthaceae family and is known for its edible fruit. Common name of this tree include Usiri (in Telugu), Nellikai (in Tamil and Kannada).

The amla have been identified as immune modulator. Amla is required in much larger amounts when the immune system is challenged. Thus, fortification of the feed in the herbal product (Amla powder) is done to improve the nutritional quality. It is the good source of vitamins at the levels indicated would be helpful in conferring the desired immunity in the birds.

Medical studies conducted on Amla fruit suggested that it has anti-viral properties and also functions as an anti-bacterial and anti-fungal agent. Amla has been particularly indicated for anemia, asthma, bleeding gums, diabetes, chronic lung disease, hyperlipidemia, yeast infections, scurvy and cancer. Amla has been known in Ayurvedic medicine for its notifying anti-ageing and immune enhancing properties. Animals fed on amla powder showed better ability for uptake and killing of bacteria, which might be due to the presence of tannins which stimulates phagocytic cells. (Koul *et al.*, 2010).

Amla is one of the richest sources of Vit-C and contain 700mg. In addition to this several active tannoid principles (Emblicanin A, Emblicanin B, Punigluconin and pedunculagin) have been identified for their health benefits (Kim *et al.*, 2005)

Amla is required for the synthesis of steroids, hormones, amino acids and mineral metabolism and to maintain immunological and to respond to physiological stress. In certain stress conditions, chickens are not able to synthesize optimum amounts and in such circumstance, vitamins and Amla powder supplementation of the diets may prove beneficial.

In recent years some herbal preparations are widely used as feed additives for enhancing growth, reducing feed cost by improving feed efficiency and for building better immunity. Amla fruit powder as feed additive has been reported to possess antistress, adaptogenic, immunogenic and growth-stimulating properties resulting in better performance of broiler (Sapkota *et al.*, 2009 and Wadhwa *et al.*, 2007).

Herbal preparations are useful as growth promoters. Ban or time bound decline in use of antibiotic growth promoters provides good scope for other growth promoters including herbal preparations for their use. Lot of herbal preparations helps the birds to fight against stress arising due to various reasons. Adaptogenic herbs like turmeric, amla, tulsi, and Ginseng etc. are being used as anti-stress factors for long years in human and animal medicines with proven results (Ranade and Desai, 2005).

There are several herbs known for their effect on instant health. They have a complex mode of action on various organs or systems due to active ingredients present in them. They are supposed to have greater impact on different factors which support growth and health, by improving physiological and immunological functions of body. Thus, they can be considered as more constant and long term solutions.

Herbal growth promoter when compared with antibiotic growth promoter, found to improve feed consumption, body weight, body weight gain and feed conversion ratio (Prasad 2004). Moreover, many herbs are known to improve digestion, metabolism and absorption of certain nutrients in bird's body and overall performance of the bird (Dobretsberger *et al.*, 1997).

Herbal growth promoters due to their multidirectional actions are also useful in controlling pathogenic bacteria without possibility of development of resistance and are also safe for animals and humans. In such manner they can work as herbal antimicrobial agents with other advantages like more economical, free from possibility of resistance, maintaining normal functions, improving production performance in broilers, improving egg size, lymphocyte percentage and egg weight in layers (Reddy *et al.*, 2002 and Shon *et al.*, 2002). Herbal feed additive is economical, without side effect, while other additives may produce adverse effects like stress, toxicity, reduction in growth rate and finally immune suppression. Hence herbal products can be safely used in poultry rearing.

1.3. Objectives of Study

The present investigation entitled, "Effect of feeding turmeric and amla on growth performance of broilers", was undertaken with the following objectives:

1. To determine growth performance of broilers fed on herbal supplemented ration
2. To study feed conversion ratio on herbal supplemented ration
3. To estimate dressing percentage and meat bone ratio

2. REVIEW OF LITERATURE



2.1 TURMERIC:

Turmeric (*Curcuma longa*) is a rhizomatous, herbaceous and perennial plant of the ginger family, Zingiberaceae with medicinal properties known to possess antimicrobial and anti-oxidant properties. Turmeric is commonly called “Pasupu” in Telugu, Kaha in Sinhala, Manjal in Tamil, “Arisina” in Kannada, “Haridra” in Sanskrit and Hakdar or Haldi in Hindi (Eevuri and Putturu, 2013).

Table 2. Taxonomic classification of turmeric

Kingdom	Plantae
Class	Liliopsida
Family	Zingiberaceae
Genus	Curcuma
Species	Curcuma longa
Chromosome no.	2n=63
Economic parts used	Rhizome

(Chattopadhyay *et al.*, 2004 and Singh, 2007)

The active ingredients of turmeric were tetrahydrocurcuminoids, curcumin, dimethoxycurcumin and bismethoxycurcumin (Al-sultan, 2003).

Therapeutic properties of turmeric includes anti-oxidant, anti-diabetic, antibacterial, antifungal, antiprotozoal, antiviral and hypocholesteremic activities (Ahmadi, 2010).

Chemical Composition of Turmeric Powder:

Dried turmeric contains 6.3% protein, 5.1% fat, 3.5% minerals, 69.4% carbohydrates and 13.1% moisture. Turmeric contains up to 5% essential oil and 5% curcumin, a polyphenol. (HMPC, 2009).

2.2 AMLA:

Amla has been known in Ayurvedic medicine for its tonifying, anti-ageing and immune enhancing properties (Lalla *et al.*, 2001).

Table 3. Taxonomic Classification of Amla

Kingdom	Plantae
Class	Magnoliopsida
Family	Phyllanthaceae
Order	Malpighiales
Genus	Phyllanthus
Species	Phyllanthus emblica

(As per USDA, 2008)

Animals fed on amla powder showed better ability for uptake and killing of bacteria. It might be due to the presence of tannins in amla which have been shown to have stimulating effect on phagocytic cells (Sai Ram *et al.*, 2001).

Amla is a superior source of vit-C and each amla fruit contains upto 700 mg of vit-C (Saini *et al.*, 2008).

Chemical Composition of Amla Powder:

Amla powder contains 5.05 to 6.78 per cent moisture, 0.23 to 0.59 per cent fat and minerals like Calcium 79.6mg, Phosphorous 12.38mg and Iron 88.03mg/100g (Mishra *et al.*, 2009).

2.3 Effect of Turmeric and Amla on Body Weight Gain

Samarasinghe *et al.* (2003) conducted an experiment on 19 and 21 days old broilers by adding turmeric at 2 and 3 g/kg and observed improved weight gain by 6.2 and 15.1 per cent, respectively at four weeks of age.

Kumar *et al.* (2005) observed that significant ($P < 0.05$) higher weight gain in broilers fed turmeric (1g/kg of diet) over those of the control group.

Namagirilakshmi (2005) reported that supplementation of turmeric powder in broiler chicken diets at 0.25, 0.50, 0.75 and 1.00 per cent levels had no effect on body weight when compared to control.

Durrani *et al.* (2006) reported that supplementation of turmeric powder in broilers diets at the rate of 0%, 0.25%, 0.5% and 1% in treatment A, B, C and D respectively. The

treatment has resulted 6% significant extra body weight gain in broilers with diet 0.5% supplementation of turmeric.

Mehala and Moorthy (2008) conducted an experiment in broilers to study the inclusion effect of Aloe vera, Curcuma longa and their combination and observed that there was no significant difference in body weight and body weight gain between treatment groups from second week to end of the experimental period except at first week ($P < 0.01$).

Mode *et al.* (2009) observed that herbal immunomodulator was evaluated in immune suppressed broiler birds in terms of body weight gain. The treatment with *Emblica officinalis* @ 3 gm /kg feed for 2 weeks were found to be effective immunomodulator in increasing body weight gain in broiler birds.

Patil *et al.* (2012) conducted trial for a period of six weeks on day old broiler chicks, uniformly distributed into three groups of 20 chicks in each as T₁, T₂ and T₃ groups. The group T₁ received standard broiler diet. Group T₂ and T₃ received standard broiler diet supplemented with 1.5 and 2g amla powder respectively. The experimental birds were reared on deep litter system and rice husk was used as litter material. The supplementation of amla powder (T₂) and (T₃) in broiler recorded significant ($P < 0.05$) improvement in all studied growth parameters *i.e.* live body weights and weekly gain over the control group (T₁).

Reddy *et al.* (2012) conducted experiment on three types of herbal preparations viz Amla, Turmeric and Tulasi either alone or in combination with nine dietary treatments to study the performance of broilers ($n=216$). The body weight gain ($P < 0.05$) was significant at 0.25% herbals combination groups compared to control group throughout the experimental period.

Chaudhary *et al.* (2015) supplemented mixture of *Curcuma longa* (*haldi*) and *Emblica officinalis* (amla) on performance of broiler chicken. Two hundred days old commercial broiler chicks were distributed randomly into four groups of 40 chicks each with replicates of 10 birds in each group. The chicks were given basal diet without any supplement (NCON) or with antibiotic (PCON), 0.5 (CEN-0.5) and 1.0% (CEN-1.0) of each *C. longa* and *E. officinalis* powder mixture. The weight gain of PCON and CEN-1.0 group broilers were significantly ($P < 0.05$) higher than NCON group.

Mondal *et al.* (2015) investigated the dietary effect of different levels of turmeric (*Curcuma longa*) powder on the performance of broiler during summer season. Four experimental rations designated as T₀, T₁, T₂ and T₃ having 0%, 0.5%, 1.0% and 1.5% Turmeric (*Curcuma longa*) powder were fed to 120 broiler chicks, randomly distributed into 12 replicates,

so as to have 3 replicates per treatment and 10 chicks per replicate. The mean body weight gain per broiler significantly increased ($P < 0.01$) by 0.5% turmeric supplemented feed compared to control feed.

Patel *et al.* (2016) conducted an experiment on commercial broiler chicks (Ven-Cobb 400 strain) divided in to three groups – T₁: Basal diet as per BIS standards; T₂: Basal diet supplemented with 0.4% of *E. officinalis* fruit powder; and T₃: Basal diet supplemented with 0.8% of *E. officinalis* fruit powder. The average body weights and body weight gain at the end of the 6th week were significantly higher ($P < 0.05$) in groups T₂ and T₃ compared to group T₁.

2.4 Effect of Turmeric and Amla on Feed Intake

Al-sultan (2003) conducted an experiment in commercial broiler chicks for five weeks period and found that feed intake was lower (2888.5g) in birds fed diet containing turmeric (0.5 per cent) when compared to control (3025.5g).

Durrani *et al.* (2006) found that inclusion of turmeric at 0.5 per cent level in broiler diet upto 35 days of age had significantly ($P < 0.05$) lowered feed consumption.

Mehala and Moorthy (2008) conducted an experiment to study the inclusion effect of Aloe vera and Curcuma longa and their combination in broilers and reported that no significant difference between treatment groups in feed intake.

Patil *et al.* (2012) conducted trial for a period of six weeks day old broiler chicks, uniformly distributed into three groups of 20 chicks in each as T₁, T₂ and T₃ groups. The group T₁ received standard broiler diet. Group T₂ and T₃ received standard broiler diet supplemented with @ 1.5 and 2g Amla powder. However, feed consumption in control group was significantly higher than supplemented group.

Reddy *et al.* (2012) conducted experiment on three types of herbal preparations viz Amla, Turmeric and Tulasi either alone or in combination with nine dietary treatments to study the performance of broilers (n=216). The better body weight gain ($P < 0.05$) and higher feed intake ($P < 0.01$) were significant in 0.25% herbals combination groups compared to control group throughout the experimental period.

Patel *et al.* (2016) conducted an experiment on commercial broiler chicks (Ven-Cobb 400 strain) divided into three groups–0%, 0.4% and 0.8% basal diet supplemented with *E. officinalis* fruit powder. Non-significant feed intake were reported among the treatment groups.

2.5 Effect of Turmeric and Amla on Feed Conversion Ratio

Al-sultan (2003) conducted an experiment in commercial broiler chicks from day old to five weeks period and found better feed efficiency (2.08) in birds fed diet containing turmeric (0.5%).

Namagirilakshmi (2005) found that supplementation of turmeric powder in broiler chicken diet at 0.50 per cent level showed better feed efficiency (1.60).

Durrani *et al.* (2006) reported that supplementation of turmeric powder at the rate of 0.5 per cent level resulted in better feed efficiency (1.2 and 2.0 in starter and finisher phase respectively).

Mehala and Moorthy (2008) observed that inclusion of Aloe vera and *Curcuma longa* and their combination had significant ($P < 0.01$) difference in feed conversion ratio at first week only during the six weeks of experimental period.

Yaghobfar *et al.* (2011) stated that there was no significant effect of feeding turmeric powder on FCR at the level of 0.4 and 0.8%.

Raghdad and Al-Jaleel (2012) reported that the inclusion of turmeric at the level of 0.50% in the diet improved body weight, FCR there were a significant difference in feed consumption.

Reddy *et al.* (2012) conducted experiment on three types of herbal preparations viz Amla, Turmeric and Tulasi either alone or in combination with nine dietary treatments to study the performance of broilers ($n=216$). However, the best feed efficiency ($P < 0.01$) was noticed in 0.25% amla powder and 0.25% herbals combination groups compared to control group.

Chaudhary *et al.* (2015) supplemented mixture of *Curcuma longa* (*haldi*) and *Emblica officinalis* (amlam) for performance of broiler chicken. The chicks were given basal diet without any supplement (NCON) or with antibiotic (PCON), 0.5 (CEN-0.5) and 1.0% (CEN-1.0) of each *C. longa* and *E. officinalis* powder mixture. PCON and CEN-1.0 groups showed significantly ($P < 0.05$) lower FCR than negative control group.

2.6 Effect of Turmeric and Amla on Mortality of Broilers

Kumar *et al.* (2005) conducted an experiment in broilers during summer and found less mortality in chicks fed turmeric @ 1g/kg diet over those of control group.

Durrani *et al.* (2006) observed no mortality upto 35 days of age when turmeric was supplemented at 0.5 per cent level in broiler diet.

Singh (2007) conducted an experiment in broilers by supplementing amla and turmeric powder @ 5g/kg of feed in broiler diet and observed no mortality during the experimental period.

Mehala and Moorthy (2008) observed 0% per cent mortality with inclusion of *Curcuma longa* and *Aloe vera* and their combination in broiler diets.

Vidhyarthi *et al.* (2008) noticed low mortality in herbal growth promoter containing amla as one of the ingredients compared to control group.

Daneshyar *et al.* (2011) reported that addition of turmeric powder in broilers diets reduce the mortality rate due to ascites.

Reddy *et al.* (2012) conducted experiment on three types of herbal preparations viz Amla, Turmeric and Tulasi either alone or in combination with nine dietary treatments to study the performance of broilers. These preparations decreased the mortality rates in chicks supplemented with to control group.

2.7 Effect of Turmeric and Amla on Carcass Traits

Al-sultan (2003) found that lower fat percentage (1.0 per cent) and higher spleen weight index in carcass of birds fed 1.0 per cent turmeric powder whereas higher bursa and thymus weight indices were detected in birds fed with 0.5 per cent turmeric.

Emadi and Kermanshahi (2007) conducted an experiment by adding turmeric rhizome (0.5 per cent and 0.75 per cent) in broiler diets and observed significant ($P \leq 0.05$) decrease in abdominal fat pad and heart weights in relation to live body weight.

Mehala and Moorthy (2008) showed that 0.1 and 0.2% turmeric powder used as feed additive had no significant effects on the performance and carcass yield of broiler chickens.

Nouzarian *et al.* (2011) reported that dietary inclusion of turmeric powder may not increase feed consumption and body weight gain in broiler chickens, but has the potential to improve feed efficiency. In addition, turmeric powder had a favorable impact on carcass fat deposition and serum triglyceride concentration at slaughter age, but foiled to enhance antibody titer production.

Reddy *et al.* (2012) conducted experiment on three types of herbal preparations viz Amla, Turmeric and Tulasi either alone or in combination with nine dietary treatments to study

the performance of broilers. They have reduced the fat accumulation, increased dressing percentage, liver weight, spleen weight and whole giblet weights.

Chaudhary *et al.* (2015) supplemented mixture of *Curcuma longa* (*haldi*) and *Emblica officinalis* (*amla*) for performance of broiler chicken. The chicks were given basal diet without any supplement (NCON) or with antibiotic (PCON), 0.5 (CEN-0.5) and 1.0% (CEN-1.0) of each *C. longa* and *E. officinalis* powder mixture. No significant effect of herbs was observed on carcass characteristics.

Mondal *et al.* (2015) investigated the dietary effect of different levels of turmeric (*Curcuma longa*) powder on the performance of broiler during summer season. Four experimental rations designated as 0%, 0.5%, 1.0% and 1.5% Turmeric (*Curcuma longa*) powder were fed to broiler chicks. The turmeric powder caused slightly increased the carcass traits of broiler chicks i.e., average weight of liver, heart and gizzard but the differences were non-significant.

2.8 Effect of Turmeric and Amla on Dressing Percentage

Durrani *et al.* (2006) found that higher (55 per cent) dressing percentage, breast, thigh and giblet weight in broilers fed diet containing 0.5 per cent turmeric powder.

Singh *et al.* (2007) conducted an experiment in broilers by supplementing amla and turmeric powder @ 5g/kg of feed in broilers diet and found improved dressing percentage in broilers.

Raghdad and Al-Jaleel (2012) conducted an experiment in broilers by using 0%, 0.5%, 1.0% and 1.5%, levels of turmeric powder in feed and found significant increase of dressing percentage.

Reddy *et al.* (2012) conducted experiment on three types of herbal preparations viz amla, turmeric and tulasi either alone or in combination with nine dietary treatments to study the performance of broilers. They have reduced the fat accumulation, increased dressing percentage, liver weight, spleen weight and whole giblet weights.

Mondal *et al.* (2015) investigated the dietary effect of different levels of turmeric (*Curcuma longa*) powder on the performance of broiler during summer season. Four experimental rations designated as 0%, 0.5%, 1.0% and 1.5% Turmeric (*Curcuma longa*) powder

were fed to broiler chicks. And significant increase ($P \leq 0.05$) in dressing yield was observed in chickens fed with 0.5% turmeric powder supplemented diets compare to control group.

2.9 Economics of Turmeric and Amla Supplementation

Kumar *et al.* (2005) observed that the feed cost per unit live body weight gain of chicks was significantly ($P \leq 0.05$) less (Rs. 19.24) for turmeric fed group as compared to control (Rs. 22.24).

Namagirilakshmi (2005) reported that supplementation of turmeric powder in broiler diet at 0.5 per cent level had lowered the cost (Rs. 23.10) of production per kg live weight compared to control (Rs. 24.62).

Durrani *et al.* (2006) informed that the cost of feed per kg of body weight gain was less (Rs. 30.00) when turmeric powder was supplemented @ 0.5 per cent in broiler feed as compared to control (Rs. 34.00).

Mehala and Moorthy (2008) founded that the returns over feed cost differ significantly ($P < 0.01$) between treatment groups upto six weeks of age, which was mainly due to difference in feed cost of Turmeric powder in broiler diets.

Patil *et al.* (2012) conducted trial for a period of six weeks on day old broiler chicks, uniformly distributed into three groups as T₁, T₂ and T₃. The group T₁ received standard broiler diet. Group T₂ and T₃ received standard broiler diet supplemented with @1.5 and 2g amla powder respectively. It was observed that the economic returns of supplemented groups were slightly lower than the unsupplemented group. The net profit per bird was slight lower in the supplemented group followed by unsupplemented group (T₁).

Reddy *et al.* (2012) conducted experiment on three types of herbal preparations viz Amla, Turmeric and Tulasi either alone or in combination with nine dietary treatments to study the performance of broilers. These preparations observed that the cost of feed has been decreased from 6.2% to 13.5%.

Patel *et al.* (2016) conducted an experiment on commercial broiler chicks divided into three groups—0%, 0.4% and 0.8% Basal diet supplemented with *E. officinalis* fruit powder. Feedcost per kg live weight production was similar among the treatment groups. The net profit per bird was the highest in group T₂ (Rs. 19.22/bird) followed by group T₃ (Rs. 17.86/bird) and the lowest in group T₁ (Rs. 14.61/bird).

3. MATERIALS AND METHODS

The present experiment entitled “Effect of feeding turmeric and amla on growth performance of broilers” was carried out at poultry unit, Department of Animal Husbandry & Dairy Science, College of Agriculture, Pune.

One day old 70 commercial straight run broiler chicks of “Vencob-400” strain were purchased from Vyankateshwara Hatchery, Pvt. Limited, Pune, Maharashtra. These chicks were randomly and equally distributed into seven treatment groups as T₀, T₁, T₂, T₃, T₄, T₅ and T₆ with 10 number of chicks in each group. All experimental chicks were reared on deep litter system in pens up to 6th week of age. The standard managerial practices provided to the experimental birds.

Table 4. Average body weight of day old chicks

Sr. No.	Treatment	Average body weight (g) of chicks
1.	T ₀	48.50±1.02
2.	T ₁	48.70±1.01
3.	T ₂	48.10±0.95
4.	T ₃	48.20±1.09
5.	T ₄	48.70±0.88
6.	T ₅	48.45±1.20
7.	T ₆	48.15±1.00

NS – Non Significant

All the broiler chicks were fed with ground maize for first two days of age. For the experiment, a commercial broiler pre-starter, starter and finisher crumbles were used. Pre-starter (0-2 weeks), starter (3-4 weeks) and finisher (5-6 weeks) was used during experimental period of 6 weeks. The diets were fed *Ad-libitum* to experimental groups by adding required amount of turmeric and amla powder as per treatment. The experiment was conducted from day old to 42 days of age.

3.1 Procurement of Feed

The experimental feed was prepared from Baramati Agro. Ltd. Baramati, Maharashtra, as per composition for the conducting feeding trial on broilers.

3.2 Composition of Feed Ingredients and Diet

Table 5. Feed ingredient composition:

Sr. No.	Ingredient Name	Pre-Starter	Starter	Finisher
1	Maize	51.95	63.25	62.45
2	Jowar	3.00	3.00	3.00
3	Bajara	7.00	0.00	4.05
4	Maize gluten	3.00	3.00	3.00
5	Meat cum bone meal	3.00	3.00	3.00
6	Rape seed doc	1.00	0.00	1.00
7	Soybean doc	28.06	24.9	20.06
8	Chicken meat meal	0.00	0.00	1.00
9	Lime stone powder	0.64	0.835	0.225
10	Di- calcium phosphate	0.595	0.455	0.68
11	Sodium bicarbonate	0.10	0.13	0.10
12	Free flow iodised salt	0.22	0.205	0.245
13	Broiler (Pre St./Strt./Finisher) pmx	1.335	1.125	1.09
14	Choline chloride-60%	0.10	0.10	0.10
	Total	100.00	100.00	100.00

3.3 Procurement of Turmeric and Amla Powder

The turmeric and amla powder was procured from local market Pune, as feed supplement for the conducting feeding trial.

3.4 Vaccination of Experimental Birds

All the experimental chicks were vaccinated with Marek's disease vaccine on the first day of life at hatchery and subsequent vaccination schedule was carried out as depicted in Table 6.

Table 6. Vaccination schedule of experimental birds

Sr. No.	Disease	Vaccine	Age of vaccination	Dose / route
1.	Ranikhet	Lasota vaccine (F1 Strain)	7 th day	One drop in eye (intraocular)
2.	Gumboro (IBD)	Gumboro vaccine	14 th day	One drop in eye (intraocular)
3.	Gumboro (IBD)	Gumboro vaccine	21 th day	Through drinking water
4.	Ranikhet	Booster dose	28 th day	Through drinking water

3.5 Housing and Management

Before arrival of broiler chicks the Pens, Drinker, Feeders and floor were cleaned, washed, disinfected and fumigated. All the experimental chicks were reared on deep litter system of rearing on rice husk (toosh) as a litter material in a well-ventilated house with identical management and environmental conditions. Provided sufficient heat and light by using electric bulbs in each group for 21 days of age. Afterwards, sufficient artificial light was provided during night hours throughout the experimental period. Fresh, clean and cool drinking water was provided to the experimental bird *ad-libitum*.

The lime stone powder was spread over the floor, to prevent microbial infection. Foot bath containing a disinfectant was provided in front of the door of poultry house. Everyone entering the house was asked to dip his or her legs in the foot bath. The shoes or any foot wear was not allowed inside the poultry house as a preventive measure. All the precautionary measures against possible infection of diseases was taken throughout the experimental period.

3.6 Treatment Details

- i. Number of treatments : 7
- ii. Total number of birds : 70 (day old chicks)
- iii. Number of birds per treatment : 10 (day old chicks)
- iv. Design of experiment : CRD

3.7 Experimental Period

The experiment was conducted from Sep.2016 to Nov.2016.

Table 7. Details of treatment and dietary supplement feeding:

Treatment	Supplement
T ₀	Basal diet (Control)
T ₁	Basal diet + 0.25% Turmeric powder (2.5 g TP / Kg of feed)
T ₂	Basal diet + 0.50% Turmeric powder (5.0 g TP / Kg of feed)
T ₃	Basal diet + 0.25% Amla powder (2.5 g AP / Kg of feed)
T ₄	Basal diet + 0.50% Amla powder (5.0 g AP / Kg of feed)
T ₅	Basal diet + 0.25% Turmeric and Amla powder (1.25 g TP & 1.25 g AP / Kg of feed)
T ₆	Basal diet + 0.50% Turmeric and Amla powder (2.5 g TP & 2.5 g AP / Kg of feed)

TP- Turmeric Powder, AP- Amla Powder.

3.8 Observations Recorded

3.8.1 Body Weight:

The weights (g) of the experimental birds were recorded individually on electronic weighing balance at weekly interval. The weighing was recorded on 7th day morning before offering fresh water and feed subsequently at 7 days interval.

3.8.2 Feed Intake:

Daily feed intake was calculated from the amount of feed consumed by each group in a day. Average feed intake was calculated from the total feed offered and the feed left over on the next day morning. Weekly feed intake was calculated by adding up the daily average feed intake of the particular week. Cumulative feed intake of particular week was calculated by adding up the weekly average feed intake of the previous weeks with the feed intake of that particular week.

Value for the weekly feed intake per bird was calculated as below.

$$\text{Weekly feed intake (g/bird)} = \frac{\text{Total feed intake by all birds in a treatment during a week.}}{\text{No. of live chicks in the treatment during that week.}}$$

Similarly, cumulative feed intake was calculated with the addition of these values upto that week.

3.8.3 Calculations:

The following observations were recorded before statistical analysis.

3.8.4 Live Weight Gain:

Weekly gain (g) in live weight per bird was calculated by subtracting live weight of previous week from that of current week. Simultaneously cumulative gains were calculated with the addition of weekly values of gain up to that week.

3.8.5 Feed Conversion Ratio (FCR):

The cumulative FCR per treatment was calculated as.

$$\text{FCR} = \frac{\text{Cumulative feed intake (g)}}{\text{Cumulative live weight gain (g)}}$$

3.8.6 Mortality:

Daily monitoring and recording on individual basis was carried out to know the mortality of the experimental birds.

3.9 Carcass Traits:

After 42nd day of age two birds from each dietary treatment were selected for carcass studies. The birds were kept off feed for eight hours prior to slaughter but drinking water was offered to them. The carcass weight was recorded.

3.9.1 Proximate Composition of Meat:

The birds were slaughtered at the end of 6th week of age. After removal of skin the dressing percentage was calculated.

Meat proximate analysis was done by following standard procedure of AOAC (2005).

3.9.2 Dressing Percentage:

Dressing percentage was calculated as per the following formula

$$\text{Dressing percentage} = \frac{\text{Dressed mass}}{\text{Live weight}} \times 100$$

3.9.3 Meat Bone Ratio:

Meat bone ratio was calculated as per the following formula

$$\text{Meat bone ratio} = \frac{\text{Wt. of carcass (g)}}{\text{Wt. of bones (g)}}$$

3.10 Cost Economics:

With an aim to assess the economy of using different stress alleviating agents, the cost of feed was calculated based on market price. Selling of bird was done as per the current NECC rate.

3.11 Statistical Analysis:

Data on body weight gain, feed intake, feed efficiency, carcass traits and economics was statistically analyzed by CRD given by Snedecor and Cochran (1994).

4. RESULTS AND DISCUSSION

The present study entitled effect of feeding turmeric and amla on growth performance of broilers. The Herbal feed supplement (feed additive) is a substance or mixture used in minor quantity other than basic feed in order to complement certain nutrients for improving performance of the birds (Narhari,1992). A variety of products are used in poultry to enhance performance. Turmeric and amla powder was tried in present study with an objective to study the effect of supplementation of turmeric and amla at different levels in broiler diets. In present chapter the observations recorded during the experiment period were analysed statistically and have been presented in a systematic manner.

The details of different parameters studied and results obtained under the analysis are discussed.

4.1 Proximate Composition of Experimental Broiler Ration

The proximate chemical composition of experimental broiler pre-starter, starter (grower) and finisher rations are presented in Table- 8. It was observed that experimental broiler rations contained adequate nutrients for growth as per BIS (1992).

4.1.1 Pre-Starter Ration

The proximate composition of experimental pre-starter ration is given in Table 8. The crude protein and calculated Metabolizable energy (ME) of the diet was 22.38 per cent and 3010 Kcal/kg, respectively.

4.1.2 Starter Ration

The proximate composition of experimental starter ration is given in Table 8. The crude protein and calculated Metabolizable energy (ME) of the diet was 20.88 per cent and 3125 Kcal/kg, respectively.

4.1.3 Finisher Ration

The proximate composition of finisher ration is given in Table 8. The crude protein and calculated metabolizable energy (ME) of the diet was 19.43 per cent and 3206 Kcal/kg, respectively.

Table 8. Proximate composition of experimental broiler ration on dry matter basis

Nutrients	Broiler ration		
	Pre-Starter	Starter	Finisher
Crude protein	22.48	20.88	19.43
Crude fibre	3.30	3.39	3.38
Ether extract	4.68	5.39	6.12
Total ash	2.89	2.91	2.72
Nitrogen free extract	66.65	67.43	68.35
Total	100	100	100
ME (Kcal/kg)	3010	3125	3206

4.2 Growth Performance

4.2.1 Cumulative Body Weight

The growth performance of experimental bird was assessed by recording the weekly body weight of an individual bird throughout the experimental period. The data pertaining to average weekly body weight is presented in Table 9. The mean of initial body weights (g) of day old broiler chicks were 48.50, 48.70, 48.10, 48.20, 48.70, 48.45 and 48.15 for treatments T₀, T₁, T₂, T₃, T₄, T₅ and T₆, respectively.

Table 9. Effect of turmeric and amla on cumulative average body weight (g) of broilers

Groups	Age in weeks						
	Initial weight	1 st week	2 nd week	3 rd week	4 th week	5 th week	6 th week
T ₀	48.50 ±1.02	201.55 ±2.56	505.35 ±12.64	979.80 ^a ±13.01	1510.80 ^a ±26.20	2093.10 ^a ±27.45	2595.90 ^a ±48.90
T ₁	48.70 ±1.01	205.70 ±1.74	511.35 ±7.12	993.60 ^a ±12.66	1596.70 ^b ±24.14	2167.50 ^{ab} ±48.34	2707.90 ^{ab} ±48.70
T ₂	48.10 ±0.95	206.80 ±2.02	527.65 ±6.77	996.60 ^a ±13.95	1611.70 ^b ±27.06	2252.70 ^{bc} ±36.89	2762.90 ^{bc} ±51.06
T ₃	48.20 ±1.09	204.25 ±2.15	522.75 ±17.99	991.10 ^a ±20.90	1631.90 ^b ±17.71	2221.40 ^{abc} ±50.13	2776.30 ^{bc} ±59.85
T ₄	48.70 ±0.88	203.60 ±2.30	505.50 ±10.27	994.90 ^a ±15.89	1655.60 ^b ±36.42	2304.90 ^c ±41.97	2858.40 ^{bcd} ±52.62
T ₅	48.45 ±1.20	202.20 ±2.39	509.15 ±13.58	1019.50 ^{ab} ±18.26	1677.30 ^b ±32.11	2335.40 ^c ±44.29	2895.90 ^{cd} ±44.60
T ₆	48.15 ±1.00	203.45 ±1.53	526.30 ±8.56	1055.70 ^b ±18.63	1679.40 ^b ±21.63	2340.90 ^c ±33.79	2930.00 ^d ±35.50
Over all Mean	48.40	203.94	515.44	1004.46	1623.34	2245.13	2789.61
SE(m)₊	1.02	2.37	12.98	16.99	29.77	45.55	54.04
CD	NS	NS	NS	48.01	84.13	128.73	152.71

a,b,c,d, Means bearing different superscripts in a column differ significantly

The average cumulative body weight (g) at 1st week of age for T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 201.55, 205.70, 206.80, 204.25, 203.60, 202.20 and 203.45, respectively. The highest weight (g) gain was observed in T₂ (206.80 g) followed by T₁, T₃, T₄, T₆, T₅ and T₀. Average weekly cumulative body weight at first week of age in all groups T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were similar among all groups.

The average cumulative body weights (g) at 2nd week of age were 505.35, 511.35, 527.65, 522.75, 505.50, 509.15 and 526.30, respectively for treatment T₀, T₁, T₂, T₃, T₄, T₅ and T₆. The highest weight (g) was observed in treatment group T₂ (527.65) followed by T₆, T₃, T₁, T₅, T₄, and T₀. Average weekly body weight of chicks at 2nd week of age in all groups T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were non-significant.

Table 10. Analysis of variance for weekly cumulative body weight (g) of broilers

Source	DF	Day old		1 st week		2 nd week	
		MSS	'F' value	MSS	'F' value	MSS	'F' value
Treatment	6	0.64	0.061	34.11	0.60	962.27	0.57
Error	63	10.50		56.26		1686.05	
Source		3 rd week		4 th week		5 th week	
		MSS	'F' value	MSS	'F' value	MSS	'F' value
Treatment	6	6515.76	2.25*	34464.70	3.89**	84421.62	4.07**
Error	63	2885.79		8862.82		20748.99	
Source		6 th week					
		MSS	'F' value				
Treatment	6	134716.10	4.61**				
Error	63	29200.29					

* Significant ($P \leq 0.05$), ** Significant ($P \leq 0.01$)

The average cumulative body weight (g) at 3rd week was ranged from 979.80 to 1055.70 g. The higher body weight was observed in T₆ (1055.70 g) and T₅ (1019.50) as compared to T₂, T₄, T₁, T₃ and T₀ groups significantly ($P \leq 0.05$) and the weight observed to treatment T₅ and T₆ have different superscripts which indicate that they are significantly differ from each other.

The average cumulative body weight (g) at 4th week of age for groups T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 1510.80, 1596.70, 1611.70, 1631.90, 1655.60, 1677.30 and 1679.40, respectively. The highest body weight was observed in T₆ (1679.40 g) followed by T₅, T₄, T₃, T₂, T₁ and T₀. The treatment T₆ was significantly ($P \leq 0.01$) superior to, T₀ only. However, treatment T₅, T₄, T₃, T₂, and T₁ were at par.

The mean body weight (g) at 5th week of age for T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 2093.10, 2167.50, 2252.70, 2221.40, 2304.90, 2335.40 and 2340.90, respectively. The higher weight was observed in treatment T₆ (2340.90 g) followed by T₅, T₄, T₂, T₃, T₁ and lowest in T₀. The ANOVA (Table 10) showed that the treatment T₆ was highly significant ($P \leq 0.01$) but at par with T₅, T₄, T₃, T₂ treatment.

The mean cumulative body weight (g) at 6th week of age for T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 2595.00, 2707.90, 2762.90, 2776.30, 2858.40, 2895.90 and 2930.00, respectively. Highest body weight was observed in T₆ (2930.00 g) followed by T₅, T₄, T₃, T₂, T₁ and T₀ group. From ANOVA (Table 10) it was observed that treatment T₆ was highly significant ($P \leq 0.01$) over other treatments but statistically at par with T₄ and T₅.

On the examination of the Table 9, it could be seen that highest body weight of 2930.00 g was obtained in broiler receiving 0.5 per cent combination of turmeric and amla powder (T₆) followed by 2895.90 g with 0.25 per cent turmeric and amla powder in (T₅) and body weight of 2858.40 g was obtained with 0.5 per cent amla powder (T₄) followed by 2776.30 g with 0.25 per cent amla powder in (T₃) and body weight of 2762.90 g was obtained with 0.5 per cent turmeric powder (T₂) followed by 2707.90 g with 0.25 per cent turmeric powder in (T₁) and lowest body weight was observed in T₀ (2520.50 g). The growth pattern indicated that optimum beneficial effect of combination of turmeric and amla could be achieved at 0.5 per cent level of inclusion as compared to 0.25 per cent of combination of turmeric and amla, 0.5, 0.25 per cent turmeric and 0.5, 0.25 per cent feeding of amla powder.

From the 1st week of age up to 2nd week non-significant differences were observed in all treatment groups. However from 3rd week onwards broilers in T₆ group grew substantially faster than the birds in other groups i.e. T₀, T₁, T₂, T₃, T₄ and T₅ resulting into higher weight gain. Therefore from the 4th week significant ($P \leq 0.01$) difference in body weight gain was recorded in T₆ group as compared to T₁, T₂, T₃, T₄, T₅ and T₀ groups.

Similar to present finding, significant effect of supplementation of turmeric and amla powder was also observed by Namagirilakshmi (2005), Durrani *et al.* (2006), Mode *et al.* (2009), Reddy *et al.* (2012) who reported increase in body weight with supplementation of turmeric and amla powder either alone or in combination as an herbal growth promoter at the level of 0.25 and Reddy *et al.* (2012), Patil *et al.* (2012), Mondal *et al.* (2015), Chaudhary *et al.* (2015) who reported increase in body weight with supplementation of turmeric and amla powder either alone or in combination as an herbal growth promoter at the level of 0.5 percent.

4.2.2 Body weight gain

The data on average weekly weight gain is presented in Table 11, the mean weight (g) gain for T₀, T₁, T₂, T₃, T₄, T₅ and T₆ treatments were 153.05, 157.00, 158.70, 156.05, 154.90,

153.75 and 155.30, respectively for first week of age. The highest weight gain was observed in group T₂ (158.70 g) followed by T₁, T₃, T₆, T₄, T₅ and T₀ groups. The analysis of variance (Table 12.) however showed that treatment effect among all treatment group were non-significant.

Table 11. Effect of turmeric and amla on average body weight (g) gain in broilers

Groups	1 st week	2 nd week	3 rd week	4 th week	5 th week	6 th week
T ₀	153.05 ±1.73	303.80 ±10.58	474.45 ^a ±4.87	531.00 ^a ±15.18	582.30 ^{ab} ±12.09	502.80 ^a ±24.70
T ₁	157.00 ±1.04	305.65 ±11.04	482.25 ^a ±7.98	603.10 ^b ±17.63	570.80 ^a ±24.11	540.40 ^{abc} ±17.62
T ₂	158.70 ±2.13	320.85 ±7.47	468.95 ^a ±8.28	615.10 ^{bc} ±18.77	541.00 ^a ±16.29	510.20 ^{ab} ±17.40
T ₃	156.05 ±1.22	318.50 ±17.44	468.35 ^a ±10.78	640.80 ^{bc} ±17.80	589.50 ^{ab} ±37.17	554.90 ^{abc} ±25.93
T ₄	154.90 ±1.49	301.90 ±7.92	489.40 ^{ab} ±8.34	660.70 ^c ±23.75	649.30 ^{bc} ±21.13	553.50 ^{abc} ±16.88
T ₅	153.75 ±1.39	306.95 ±12.20	510.35 ^{bc} ±14.25	657.80 ^c ±16.86	658.10 ^c ±30.34	560.50 ^{bc} ±15.58
T ₆	155.30 ±1.31	322.85 ±7.85	529.40 ^c ±10.79	623.70 ^{bc} ±12.12	661.50 ^c ±16.17	589.10 ^c ±17.23
Mean	155.54	311.50	489.02	618.89	621.79	544.49
SE(m)±	1.51	11.13	9.20	17.75	23.91	19.71
CD	NS	NS	27.47	50.16	67.58	55.71

a,b,c, Means bearing different superscripts in a column differs significantly

The mean body weight (g) gain (Table 11) for T₀, T₁, T₂, T₃, T₄, T₅ and T₆ groups were 303.80, 305.65, 320.85, 318.50, 301.90, 306.95 and 322.85, respectively at 2nd weeks of age. The highest body weight gain was observed in group T₆ (322.85 g) followed by T₂, T₃, T₅, T₁, T₀ and T₄ groups. The analysis of variance (Table 12) for mean weekly cumulative body weight gain at 2nd week of age showed that treatment T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were statistically non-significant.

The mean weekly body weight (g) gain (Table 11) for T₀, T₁, T₂, T₃, T₄, T₅ and T₆ at 3rd week of age were 474.45, 482.25, 468.95, 468.35, 489.40, 510.35 and 529.40, respectively. The highest weight gain was observed in treatment T₆ (529.40 g) followed by T₅, T₄, T₁, T₀, T₂ and T₃. The analysis of variance (Table 12) showed that the treatment T₆ was highly significant

($P \leq 0.01$) over other treatments. However treatment T_6 and T_5 were at par with each other. Statistically significant difference was observed in other group.

Table 12. Analysis of variance for weekly body weight (g) gain in broilers

Source	D.F.	1 st week		2 nd week		3 rd week	
		MSS	'F' value	MSS	'F' value	MSS	'F' value
Treatment	6	37.08	1.62	786.03	0.63	5289.72	5.60**
Error	63	22.80		1238.36		944.62	
		4 th week		5 th week		6 th week	
		MSS	'F' value	MSS	'F' value	MSS	'F' value
Treatment	6	19589.31	6.22**	15372.01	2.69*	8944.18	2.30*
Error	63	3150.37		5717.65		3886.39	

* Significant ($P \leq 0.05$), ** Significant ($P \leq 0.01$)

The mean body weight (g) gain (Table 11) at 4th week of age for treatment T_0 , T_1 , T_2 , T_3 , T_4 , T_5 and T_6 were 531.00, 603.10, 615.10, 640.80, 660.70, 657.80 and 623.70, respectively. The highest body weight gain was observed in T_4 group (660.70 g) followed by T_5 , T_3 , T_6 , T_2 , T_1 and T_0 group. From the analysis of variance (Table 12) it was observed that the group T_4 is highly significant ($P \leq 0.01$) over other treatments.

The mean body weight (g) gain (Table 11) at 5th week of age for T_0 , T_1 , T_2 , T_3 , T_4 , T_5 and T_6 were 582.30, 570.80, 541.00, 589.50, 649.30, 658.10 and 661.50, respectively. The highest weight gain was observed in T_6 (661.50 g) followed by T_5 , T_4 , T_2 , T_3 , T_0 and T_1 . The analysis of variance (Table 12) for mean weekly average body weight gain at 5th week of age showed that treatment T_0 , T_1 , T_2 , T_3 , T_4 , T_5 and T_6 were statistically significant.

The body weight gain (g) (Table 11) at 6th week of age for T_0 , T_1 , T_2 , T_3 , T_4 , T_5 and T_6 groups were 502.80, 540.40, 510.20, 554.90, 553.50, 560.50 and 589.10, respectively. The highest weight gain was observed in treatment T_6 (589.10 g) followed by T_5 , T_4 , T_3 , T_1 , T_2 and T_0 . Statistical analysis (Table 12) showed that group T_6 was significantly ($P \leq 0.05$) superior over other treatments.

The value of weekly gain in body weight indicate that broiler chicks receiving T_6 (0.5 per cent Turmeric and Amla powder) and T_5 (0.25 per cent Turmeric and Amla powder) grew significantly ($P \leq 0.05$) faster as compared to T_4 (0.5 per cent Amla powder), T_3 (0.25 per cent Amla powder), T_2 (0.5 per cent Turmeric powder), T_1 (0.25 per cent Turmeric powder) and T_0 . From Table 11, it was observed that average weekly gain in body weight (g) followed the trend of non-significant effect of dietary treatment among experimental birds 1st and 2nd week. However, significant effect was show from 3rd, 4th, 5th and 6th week indicating anabolic property

of Turmeric and Amla powder which might have enhanced utilization of nutrients resulting in to growth elevation.

Similar results were observed by Durrani *et al.* (2006) and Mondal *et al.* (2015), addition of 0.5% turmeric powder in broilers feed has resulted in significant body weight gain in broilers by 6-8% extra with diet supplementation of turmeric. Reddy *et al.* (2012) found significant better body weight gain ($P \leq 0.05$) in 0.25% herbal combination groups compared to control group. Patel *et al.* (2016), observed body weight gain at the end of the 6th week was significantly higher ($P \leq 0.05$) in 0.4% amla treated group compared to other groups.

4.2.3 Feed Intake

Feed intake of experimental broiler chicks was recorded at weekly interval throughout the experimental period. The average weekly feed intake of broiler chicks was presented in Table 13.

Average feed intake (g) at 1st week of age for T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 147.80, 149.65, 149.45, 146.60, 147.10, 149.35 and 145.60, respectively. Table 13 showed that the feed intake in T₁ group was higher than T₂, T₅, T₀, T₄, T₃, and T₆. The analysis of variance (Table 14) showed that feed intake among the treatment groups was non-significant.

Average feed intake (g) at 2nd week of age for T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 357.55, 352.35, 355.60, 356.95, 357.10, 354.50 and 352.15, respectively. The highest feed intake was observed in T₀ (357.55 g), followed by T₄, T₃, T₂, T₅, T₁ and T₆. The analysis of variance (Table 11) showed that feed intake in T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were non-significant.

The average feed intake (g) at 3rd week of age for treatment T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 654.15, 636.75, 641.95, 641.35, 634.80, 650.00 and 651.80, respectively. The higher feed intake was observed in T₀ (654.15) followed by T₆, T₅, T₂, T₃, T₁ and T₄. Analysis of variance (Table 11) showed that feed intake in group T₀ was highly significant ($P \leq 0.01$), treatment T₀, T₅, T₆ and treatment T₁, T₂, T₃ and T₁, T₂, T₃ at par.

The average feed intake (g) at 4th week of age for treatment T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 853.95, 852.20, 845.20, 849.65, 851.70, 849.15 and 845.15, respectively. Feed intake observed to be highest in T₀ (853.95 g) followed by T₄, T₃, T₅, T₁, T₂ and T₆ groups. Analysis of variance (Table 14) showed that feed intake in group T₀ was highly significant ($P \leq 0.01$), treatment T₀, T₁, T₃, T₄ and treatment T₁, T₃, T₄, T₅ and T₂, T₃, T₅, T₆ were at par.

Table 13. Effect of turmeric and amla on feed intake (g) in broilers

Groups	1st week	2nd week	3rd week	4th week	5th Week	6th week	Overall Avg. feed intake
T₀	147.80 ±2.11	357.55 ±1.30	654.15 ^c ±1.23	853.95 ^c ±1.92	1039.20 ^b ±2.81	1162.40 ^c ±1.22	4215.05 ±1.77
T₁	149.65 ±1.10	352.35 ±2.81	636.75 ^{ab} ±3.53	852.20 ^{bc} ±0.74	1028.35 ^a ±2.55	1160.85 ^c ±0.75	4180.15 ±1.91
T₂	149.45 ±1.05	355.60 ±1.87	641.95 ^b ±2.25	845.20 ^a ±2.49	1028.05 ^a ±2.79	1155.45 ^{ab} ±2.10	4175.70 ±2.09
T₃	146.60 ±2.41	356.95 ±0.43	641.35 ^{ab} ±3.01	849.65 ^{abc} ±1.02	1037.00 ^b ±0.66	1152.50 ^a ±1.81	4184.05 ±1.56
T₄	147.10 ±1.71	357.10 ±1.05	634.80 ^a ±0.99	851.70 ^{bc} ±1.29	1037.90 ^b ±0.71	1161.25 ^c ±0.81	4189.85 ±1.09
T₅	149.35 ±1.13	354.50 ±0.56	650.00 ^c ±1.03	849.15 ^{ab} ±1.06	1036.85 ^b ±1.64	1159.90 ^{bc} ±1.31	4199.75 ±1.12
T₆	145.60 ±1.76	352.15 ±1.60	651.80 ^c ±1.40	845.15 ^a ±1.92	1027.95 ^a ±2.05	1152.30 ^a ±1.98	4174.95 ±1.78
Mean	147.94	355.17	644.40	849.57	1033.61	1157.66	4188.50
SE(m)_±	2.12	1.75	2.34	1.67	2.41	1.63	-
CD	NS	NS	6.61	4.72	6.80	4.62	-

a,b,c, Means bearing different superscripts in a column differ significantly

The average feed intake (g) at 5th week of age for treatment T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 1039.20, 1028.35, 1028.05, 1037.00, 1037.90, 1036.85 and 1027.95, respectively. Highest feed intake was recorded in T₀ (1039.20 g) followed by T₁, T₄, T₃, T₅, T₂ and T₆. ANOVA (Table 14) showed that feed intake in group T₀ was highly significant ($P \leq 0.01$), treatment T₀, T₃, T₄, T₅ and treatment T₁, T₂, T₆ at par.

The average feed intake at 6th week of age for groups T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 1162.40, 1160.85, 1155.45, 1152.50, 1161.25, 1159.90 and 1152.30g, respectively. Highest feed intake was observed in treatment T₀ followed by T₄, T₁, T₅, T₂, T₃ and T₆, (Table 13) indicated that groups T₆ and T₃ consumed significantly ($P \leq 0.01$) less feed than other treatments.

Table 14. Analysis of variance for weekly feed intake (g) in broilers

Source	D.F	1 st week		2 nd week		3 rd week	
		MSS	'F' value	MSS	'F' value	MSS	'F' value
Treatment	6	25.31	0.56	50.44	1.64	578.62	10.58**
Error	63	45.08		30.74		54.71	
		4 th week		5 th week		6 th week	
		MSS	'F' value	MSS	'F' value	MSS	'F' value
Treatment	6	115.76	4.15**	270.43	4.67**	193.68	7.25**
Error	63	27.90		57.89		26.69	

** Significant (P<0.01)

Broiler chicks receiving control diet consumed more quantity of total feed (4215.05 g) as compared to supplemented groups. Birds in T₁ (receiving 0.25 per cent Turmeric powder) group consumed 4180.15 g of feed. Birds in T₂ group (receiving 0.5 per cent Turmeric powder) consumed 4175.70 g of feed. Birds in T₃ group (receiving 0.25 per cent amla powder) consumed 4184.05 g of feed. Birds in T₄ group (receiving 0.5 per cent amla powder) consumed 4189.85 g of feed. Birds in T₅ group (receiving 0.25 per cent Turmeric and amla powder) consumed 4199.75 g of feed and group T₆ (receiving 0.5 per cent turmeric and amla powder) required 4174.95g of feed. From these results it was found that group T₆ consumed less feed as compared to rest of the groups. While comparing with growth performance and weight gain, group T₆ had lowest feed intake and higher weight gain than other treatments.

Al-sultan (2003) and Durrani *et al.* (2006) conducted an experiment in commercial broiler chicks for five weeks period and found that feed intake was lower (2888.5g) in birds fed diet containing turmeric (0.5 per cent) when compared to control (3025.5g). Reddy *et al.* (2012) also reported significant higher feed intake ($P \leq 0.01$) in 0.25% herbals combination groups compared to control group throughout the experimental period.

4.2.4 Feed Conversion Ratio

The mean weekly feed conversion ratio and their standard error at different weeks of age are presented in Table 15 and the ANOVA is given in Table 16.

The average feed conversion ratio for 1st week of age in groups T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 0.97, 0.95, 0.94, 0.94, 0.95, 0.97 and 0.94, respectively. Better Feed conversion ratio was recorded in group T₂, T₃, T₆, T₁, T₄, T₅ and T₀, respectively. However, from ANOVA (Table 16) it was showed that all groups were statistically non-significant.

Table 15. Effect of turmeric and amla on feed conversion ratio in broilers

Groups	1 st week	2 nd week	3 rd week	4 th week	5 th week	6 th week	Overall mean
T ₀	0.97 ±0.01	1.19 ±0.04	1.38 ^{cd} ±0.01	1.62 ^b ±0.04	1.79 ^b ±0.04	2.35 ^c ±0.09	1.55 ^b ±0.04
T ₁	0.95 ±0.00	1.17 ±0.01	1.32 ^{bcd} ±0.01	1.42 ^b ±0.04	1.83 ^b ±0.07	2.17 ^{abc} ±0.08	1.48 ^{ab} ±0.03
T ₂	0.94 ±0.00	1.11 ±0.01	1.37 ^{cd} ±0.02	1.38 ^{ab} ±0.04	1.61 ^a ±0.04	2.28 ^{bc} ±0.07	1.45 ^{ab} ±0.03
T ₃	0.94 ±0.01	1.15 ±0.06	1.38 ^c ±0.03	1.34 ^{ab} ±0.04	1.81 ^b ±0.09	2.12 ^{ab} ±0.10	1.46 ^{ab} ±0.05
T ₄	0.95 ±0.01	1.19 ±0.03	1.30 ^{abc} ±0.02	1.30 ^a ±0.05	1.61 ^a ±0.05	2.11 ^{ab} ±0.06	1.41 ^a ±0.04
T ₅	0.97 ±0.00	1.17 ±0.04	1.28 ^{ab} ±0.04	1.30 ^a ±0.03	1.61 ^a ±0.06	2.08 ^{ab} ±0.05	1.40 ^a ±0.04
T ₆	0.94 ±0.01	1.10 ±0.02	1.24 ^a ±0.02	1.36 ^{ab} ±0.01	1.56 ^a ±0.03	1.97 ^a ±0.05	1.36 ^a ±0.02
Mean	0.95 ±0.003	1.15 ±0.01	1.32 ±0.01	1.39 ±0.03	1.69 ±0.06	2.16 ±0.47	1.44 ±0.09
SE(m)±	0.01	0.04	0.03	0.04	0.06	0.07	0.04
CD	NS	NS	0.07	0.11	0.17	0.21	0.13

a,b,c,d, Means bearing different superscripts in a column differ significantly

The average feed conversion ratio for 2nd week of study in groups T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 1.19, 1.17, 1.11, 1.15, 1.19, 1.17, and 1.10g, respectively. From ANOVA (Table 16) it was observed that, all groups were statistically non-significant.

The average feed conversion ratio for 3rd week of age for groups T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 1.38, 1.32, 1.37, 1.38, 1.30, 1.28, and 1.24g, respectively. Better Feed conversion ratio was recorded in group T₆ as compared to other groups. However, from ANOVA (Table 16) it was showed that group T₆ was significantly ($P \leq 0.01$) superior over T₀, T₁, T₂ and T₃ whereas at par with T₄, T₅.

The average feed conversion ratio for 4th week of age for groups T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 1.62, 1.42, 1.38, 1.34, 1.30, 1.30 and 1.36g, respectively. The analysis of variance (Table 16) showed that treatment T₄ and T₅ was highly significant ($P \leq 0.01$) over other treatments.

Table 16. Analysis of variance for average feed conversion ratio of experimental birds

Source	D.F.	1 st week		2 nd week		3 rd week	
		MSS	'F' value	MSS	'F' value	MSS	'F' value
Treatment	6	0.002	2.188	0.013	0.874	0.030	4.618**
Error	63	0.001		0.015		0.007	
		4 th week		5 th week		6 th week	
		MSS	'F' value	MSS	'F' value	MSS	'F' value
Treatment	6	0.122	8.364**	0.129	3.490**	0.161	3.005*
Error	63	0.015		0.037		0.053	

* Significant ($P < 0.05$), ** Significant ($P < 0.01$)

The average feed conversion ratio for 5th week of age for groups T₀, T₁, T₂, T₃, T₄, T₅ and T₆ were 1.79, 1.83, 1.61, 1.81, 1.61, 1.61 and 1.56g, respectively. The analysis of variance (Table 16) showed that treatment T₆ was significantly ($P \leq 0.01$) superior over others.

The average feed conversion ratio for 6th week of age for T₀, T₁, T₂, T₃, T₄, T₅ and T₆ groups were 2.35, 2.17, 2.28, 2.12, 2.11, 2.08 and 1.97g, respectively. From ANOVA (Table 16) it was observed that, treatment T₆ was significantly superior ($P \leq 0.05$) over all group.

The feed conversion ratio was better in broilers fed turmeric and amla powder either alone or in combination compared to control during pre- starter, starter and finisher phases. It might be due to the antimicrobial and antioxidant properties of herbals and their combinations in broiler diets which exerted better feed conversion ratio.

The results in the present investigation are in conformity with the findings of Al-Sultan (2003), Namagirilakshmi (2005) and Durrani *et al.* (2006) at the levels of 0.5 per cent whereas Pande *et al.* (2000) and Reddy *et al.* (2012) observed significant ($P \leq 0.01$) improvement of FCR fed with Amla and Turmeric either alone or in combination at the levels of 0.25 per cent in treatment groups.

4.2.5 Mortality

The overall mortality was observed 0% in broilers of various groups during the experimental period.

4.3. Carcass Traits

The effect of feeding turmeric and amla powder either alone or in combination on different carcass traits are presented in Table17.

Table 17. Effect of turmeric and amla on carcass traits in broilers (live weight basis in gram)

Treat. / Parameter	Heart	Liver	Gizzard
T₀	16.00±2.00	50.00±1.00	81.00±2.00
T₁	14.00±0.00	42.00±2.00	86.00±6.00
T₂	14.00±1.00	40.00±1.00	92.00 ±3.00
T₃	18.00±1.00	46.00±2.00	92.00±1.00
T₄	16.00 ±0.00	44.00±2.00	86.00±4.00
T₅	16.00 ±1.00	42.00±2.00	96.00±2.00
T₆	14.00±01.00	48.00±3.00	98.00±2.00
Mean	15.43±0.86	44.57±1.85	90.14±2.85
SE (±)	1.07	1.96	3.25
CD	NS	NS	NS

NS– Non-Significant

Table 18. Analysis of variance for carcass traits of experimental birds

Source	DF	Heart		Liver		Gizzard	
		MSS	‘F’ value	MSS	‘F’ value	MSS	‘F’ value
Treatment	6	4.57	2.00	25.90	3.36	73.62	3.48
Error	21	2.28		7.71		21.14	

The average weights (g) of heart 16.00, 14.00, 14.00, 18.00, 16.00, 16.00 and 14.00, liver 50.00, 42.00, 40.00, 46.00, 44.00, 42.00, 48.00 and gizzard 81.00, 86.00, 92.00, 92.00, 86.00, 96.00 and 98.00 were observed from (Table 17) of respectively for treatment group T₀, T₁, T₂, T₃, T₄, T₅, and T₆. The highest heart weight T₃ (18.00 g), liver weight T₀ (50.00 g) and gizzard weight T₆ (98.00 g) were observed to be non-significant among all treatment groups (Table 18).

4.3.1. Proximate Composition of Meat

The per cent moisture, dry matter, ash, protein and fat content under each treatment were 72.00, 71.50, 72.75, 73.50, 74.25, 71.25 and 73.50 per cent moisture; 28.00, 28.50, 27.25, 26.50, 25.75, 28.75 and 26.50 per cent dry matter; 0.99, 1.03, 1.06, 1.09, 0.99, 1.08 and 0.99 per cent ash; 17.55, 18.89, 18.20, 18.91, 19.32, 20.36, and 22.03 per cent protein and 3.74, 3.94,

3.85, 4.28, 4.42, 4.30 and 4.93 per cent fat in T₀, T₁, T₂, T₃, T₄, T₅ and T₆ group, respectively were present.

Table 19. Effect of Turmeric and Amla either alone or in combination on proximate composition of meat in different treatments:

Treat. / Parameter	Moisture	Dry Matter	Ash	Crude Protein	Fat
T ₀	72.00±1.80	28.00±1.00	0.99±0.01	17.55 ^a ±0.55	3.74±0.74
T ₁	71.50±0.50	28.50±1.50	1.03±0.03	18.89 ^{ab} ±0.89	3.94±0.44
T ₂	72.75±1.25	27.25±0.75	1.06±0.03	18.20 ^{ab} ±0.20	3.85±0.15
T ₃	73.50±2.00	26.50±0.75	1.09±0.01	18.91 ^{ab} ±0.91	4.28±0.72
T ₄	74.25±1.25	25.75±0.75	0.99±0.03	19.32 ^{ab} ±0.68	4.42±0.42
T ₅	71.25±1.75	28.75±0.75	1.08±0.08	20.36 ^{bc} ±0.36	4.30±0.10
T ₆	73.50±0.50	26.50±0.50	0.99±0.01	22.03 ^c ±0.53	4.93±0.43
Mean	72.67±0.48	27.32±0.38	1.03±0.02	19.32±0.42	4.11±0.28
SE (±)	1.31	0.90	0.04	0.64	0.49
CD	NS	NS	NS	2.16	NS

a,b,c, Means bearing different superscripts in a column differ significantly

Statistically crude protein (CP) content in T₆ (22.03) was highest but the other parameters in proximate composition of meat was non-significant, which indicated that though the turmeric and amla (powder) improved body weight, body weight gain, feed conversion ratio significantly but not the composition of meat except crude protein.

Table 20. Analysis of variance for proximate composition of meat in different treatments

Source	DF	Moisture		Dry Matter		Crude protein	
		MSS	'F' value	MSS	'F' value	MSS	'F' value
Treatment	6	2.57	0.65	2.57	1.56	4.39	5.42*
Error	21	3.98		1.64		0.81	
		Fat		Ash			
		MSS	'F' value	MSS	'F' value		
Treatment	6	0.33	0.70	0.004	1.29		
Error	21	0.47		0.003			

* Significant (P≤0.05)

4.3.2. Dressing Percentage and Meat Bone Ratio

The effect of feeding turmeric and amla powder either alone or in combination on different dressing percentage and meat bone ratio is presented in table no. 21.

At the end of 42nd day of age, two birds per treatment group were randomly picked up and slaughtered as per the method of Arumugam and Panda (1970). The pre-slaughter live weight, heart weight, liver weight and gizzard weight were recorded.

It was observed from (Table 21) that the average dressing percentage of T₀, T₁, T₂, T₃, T₄, T₅, and T₆ was 65.81, 67.55, 68.02, 68.93, 66.71, 69.15 and 72.20, respectively. Significantly higher dressing percentage was observed in T₆ (72.20 %) followed by T₅, T₃, T₂, T₁, T₄ and T₀ treatments.

The meat bone ratio of T₀, T₁, T₂, T₃, T₄, T₅, and T₆ was 13.35, 14.19, 14.35, 13.28, 13.42, 14.29 and 14.36, respectively (Table 21). Lower meat bone ratio was observed in T₃ (13.28) which was statistically significant (ANOVA Table 22) and treatment T₀, T₃, T₄; T₁, T₂, T₅ and T₆ at par to each other.

Table 21. Effect of Turmeric and Amla on dressing percentage and Meat bone ratio on live weight basis

Parameter/ Treat.	Dressing percentage (%)	Meat bone ratio (%)
T ₀	65.81 ^a ±1.12	13.35 ^a ±0.02
T ₁	67.55 ^{abc} ±0.15	14.19 ^b ±0.36
T ₂	68.02 ^{bc} ±0.09	14.35 ^b ±0.05
T ₃	68.93 ^c ±0.78	13.28 ^a ±0.05
T ₄	66.71 ^{bc} ±0.27	13.42 ^a ±0.02
T ₅	69.15 ^c ±0.11	14.29 ^b ±0.18
T ₆	72.20 ^d ±0.27	14.36 ^b ±0.05
Mean	68.34±0.40	13.89±0.10
SE (±)	0.54	0.16
CD	1.81	0.53

a,b,c,d Means bearing different superscripts in a column differ significantly

Table 22. Analysis of variance for Dressing % and Meat Bone Ratio in different treatments

Source	D.F.	Dressing %		Meat Bone Ratio	
		MSS	'F' value	MSS	'F' value
Treatment	6	17.15	29.11**	1.04	20.99**
Error	21	0.59		0.05	

** Significant ($P \leq 0.01$)

4.4. Economics

With an aim to assess the economy of using different stress alleviating agents, the costs of feeds were calculated based on market price. Selling of bird was done as per the current NECC rate.

Economical data of experiment shows that the total cost (Rs./kg) of feed was 27.00, 27.75, 28.50, 27.60, 28.20, 27.67 and 28.35 in treatment T₀, T₁, T₂, T₃, T₄, T₅ and T₆ respectively.

Average total feed consumption of per bird was 4.21, 4.18, 4.17, 4.19, 4.19, 4.20 and 4.17 kg, respectively in T₀, T₁, T₂, T₃, T₄, T₅ and T₆ treatment groups. It shows that higher feed was consumed by T₀ group than others.

The total cost of production (Rs.) per bird is 145.81, 148.00, 151.01, 147.48, 150.15, 148.21 and 150.36 in treatment T₀, T₁, T₂, T₃, T₄, T₅ and T₆ respectively.

The average body weight at the end of sixth week of age were 2.59, 2.70, 2.76, 2.77, 2.85, 2.89 and 2.93 kg in T₀, T₁, T₂, T₃, T₄, T₅ and T₆ treatment groups, respectively. The higher net profit was obtained in T₆ (Rs. 54.74/bird) followed by T₅ (Rs. 54.51/bird), T₄ (Rs. 49.93/bird), T₃ (Rs. 46.86/bird) T₂ (Rs. 42.40/bird), T₁ (Rs. 41.55/bird) and T₀ (Rs. 35.91/bird).

The cost benefit ratio of per bird was 1.25, 1.28, 1.28, 1.32, 1.33, 1.37 and 1.36 respectively in T₀, T₁, T₂, T₃, T₄, T₅ and T₆ treatment groups.

Table 23. Effect of Turmeric and Amla on the cost of broiler rearing

Sr. No.	Particulars	T0	T1	T2	T3	T4	T5	T6
1.	Cost of day old chick (Rs.)	28.00	28.00	28.00	28.00	28.00	28.00	28.00
2.	Cost of feed (Rs/kg)	27.00	27.00	27.00	27.00	27.00	27.00	27.00
3.	Cost of Turmeric & Amla (Powder) (Rs/Kg of feed)	0.00	0.75	1.5	0.60	1.20	0.67	1.35
4.	Total cost of feed (Rs/kg)	27.00	27.75	28.50	27.60	28.20	27.67	28.35
5.	Average total feed consumed per bird (Kg)	4.21	4.18	4.17	4.19	4.19	4.20	4.17
6.	Cost of feed consumed per bird (Rs.) (4x5)	113.81	116.00	119.01	115.48	118.15	116.21	118.36
7.	Average body weight at the end of 6th week (Kg)	2.59	2.70	2.76	2.77	2.85	2.89	2.93
8.	Feed consumption per kg live weight gain (Kg)	1.62	1.54	1.51	1.51	1.47	1.45	1.42
9.	Cost of feed per kg live weight gain (Rs.)	43.84	42.84	43.07	41.59	41.34	40.13	40.40
10	Rearing Cost (vaccines, water, electricity, labour charge, etc.) per bird (Rs.)	4.00	4.00	4.00	4.00	4.00	4.00	4.00
11.	Total cost of production (Rs.) (1+6+10)	145.81	148.00	151.01	147.48	150.15	148.21	150.36
12.	Average price realized @ Rs. 70 per kg live weight (Rs.)	181.71	189.55	193.40	194.34	200.09	202.71	205.10
13.	Net profit per bird (Rs.) (12-11)	35.91	41.55	42.40	46.86	49.93	54.51	54.74
14.	Cost benefit ratio	1.25	1.28	1.28	1.32	1.33	1.37	1.36

5. SUMMARY AND CONCLUSION



5.1 SUMMARY

The present investigation entitled “Effect of feeding turmeric and amla on growth performance of broilers” was carried out to assess the effect of feeding of turmeric and amla on body weight, body weight gain, feed intake, feed conversion ratio (FCR), meat traits of broiler production.

Seventy, day old commercial broiler chicks of ‘Vencob-400’ strain were distributed into 7 treatment groups T₀, T₁, T₂, T₃, T₄, T₅ and T₆, with 10 chicks in each group. Each dietary treatment was having ten replicates. The experimental broiler chicks were reared on deep litter system in well ventilated shed from 0 – 6 weeks. The turmeric and amla powder was added in experimental ration individually at the rate of 0.25 and 0.5 per cent to T₁, T₂, T₃, and T₄, respectively and with combination in treatment T₅ and T₆. The control group T₀ was without turmeric and amla powder.

5.1.1 Cumulative Body Weight

The cumulative average body weight at the end of sixth week of age were 2595.90, 2707.90, 2762.90, 2776.30, 2858.40, 2895.90 and 2930.00g in T₀, T₁, T₂, T₃, T₄, T₅ and T₆ treatment groups, respectively.

The significant difference in weekly body weight was found from third week onwards, significantly better growth was recorded in T₆ (2,930.00 g) and T₅ (2,895.90 g) groups during third to sixth week. This indicated that beneficial effect of feeding turmeric and amla powder were recorded on 0.25 and 0.5 per cent level alone or with combination.

5.1.2 Body Weight Gain

The initial body weight gain of broilers for all treatment groups were almost similar showing statistically non-significant difference up to second week of age.

The average body weight gain (g) at sixth weeks of age were 502.80, 540.40, 510.20, 554.90, 553.50, 560.50 and 589.10 in T₀, T₁, T₂, T₃, T₄, T₅ and T₆ treatment groups, respectively. The treatment T₆ had significantly higher body weight gain as compared to others.

5.1.3 Feed Intake

The average total weekly feed intake g/bird during the experimental period at end of 6th week was recorded as 1162.40, 1160.85, 1155.45, 1152.50, 1161.25, 1159.90

and 1152.30g for T₀, T₁, T₂, T₃, T₄, T₅ and T₆ treatment groups, respectively. The feed intake of all the birds receiving turmeric and amla powder 0.25 and 0.5 per cent level was slightly similar to all treatments.

The average overall feed intake at the end of 6th week of age were 4215.05, 4180.15, 4175.70, 4184.05, 4189.85, 4199.75 and 4172.95g in T₀, T₁, T₂, T₃, T₄, T₅ and T₆ treatment groups, respectively. And overall feed intake of broilers for the treatment groups supplemented with turmeric and amla either alone or combination was low as compared to control group.

5.1.4 Feed Conversion Ratio (FCR)

The average weekly feed efficiency at 6th week age were 2.35, 2.17, 2.28, 2.12, 2.11, 2.08 and 1.97 in T₀, T₁, T₂, T₃, T₄, T₅ and T₆, treatment groups, respectively, and FCR was observed to be statistically significant in treatment group T₀, T₁, T₃, T₄, T₅, and T₆. The FCR was found to be statistically significant for different treatment groups in 3rd, 4th and 5th week onwards.

5.1.5 Mortality Percentage

The overall mortality in broilers of various groups during the experimental period was observed zero per cent.

5.2 CONCLUSION

Feeding of Turmeric and Amla powder with broiler ration as feed supplement was beneficial in improving average weekly body weight, body weight gain and average weekly feed intake along with improving feed conversion ratio, dressing percentage and also fat and protein content in meat. The inclusion of turmeric and amla at 0.25 and 0.5 per cent combination in broiler ration as feed supplement found to be better in terms of overall performance of broiler as compared to other treatments.

1. The effect of feeding turmeric and amla on growth performance of broilers indicated that combination of 0.5% (2.5g TP & 2.5g AP / Kg of feed) had significantly increases the body weight and body weight gain.
2. The average overall feed intake at the end of 6th week of age was observed to be approximately similar in all treatment groups.
3. The dressing percentage and meat bone ratio was noted comparatively high in T₆, which was the combination of turmeric and amla powder treated with 0.5% (2.5g TP & 2.5g AP / Kg of feed) level.

4. Proximate composition of meat indicated that treatment T₆ had higher fat and crude protein, which was the combination of turmeric and amla powder treated with 0.5% (2.25 g TP & 2.25 g AP / Kg of feed) level.
5. Turmeric and amla in combination at 0.25% (1.25g TP & 1.25g AP / Kg of feed) and 0.5% (2.5g TP & 2.5g AP / Kg of feed) levels in broiler diets to get the beneficial cost higher compared to rest of group.

Date: / / 2018

Student Signature

(Gyan Chandra)

6. LITERATURE CITED



- Ahmadi F. 2010. Effect of turmeric powder on performance, oxidative stress state and some of blood parameters in fed on diets containing aflatoxin. *Global Veterinarian*. 5: 312-317.
- Al-Sultan S.I. 2003. The effects of *Curcuma longa* (turmeric) on overall performance of broiler chicken. *Int. J. Poult. Sci.* 2: 354-353.
- AOAC, 2005. Association of Official Analytical Chemists. Official Methods of Analysis. Washington, DC.
- Arumugam M.P., Panda B. 1970. Processing and Inspection of poultry. Indian Vet. Res. Institute, Izatnagar, Bareilly U.P.
- Bureau of Indian Standards (1992). Indian Standard Poultry Feed Specification. IV Revision, Manak Bhavan, 9, Bahadurshah Zafar Marg, New Delhi.
- Chattopadhyay I, Biswas K, Bandyopadhyay U and Ranajit K Banerjee 2004. Turmeric and Curcumin: biological actions and medicinal applications. *Curr. Sci.* 87: 44-53.
- Chaudhary R.K., Singh V.K., Singh S.P., Gautam S. and Tewari D. 2015. Effect of Herbal Supplements of *Curcuma longa*, *Emblica officinalis* and *Nigella sativa* on Performance of Broilers *Indian J. Ani. Nutr.* 32 (1): 90-95.
- Daneshyar M., Gghandkanlo M. Alizadeh, Bayeghra F. Sabzi, Farhangpajhah F. and Aghaei M. 2011. Effect of dietary turmeric supplementation on plasma lipoproteins, meat quality and fatty acid composition in broilers. *South African J. Ani. Sci.* 41 (No. 4).
- Dobretsberger, M., M. Glatzl and W. G. Krafek, 1997. Natural products for enhanced poultry productivity *Indian J. Indg. Med.* 18: 101-108.
- Durrani F.R. Mohammad Ismail, Asad Sultan, Suhail S.M., Naila Chand and Durrani Z. 2006. Effects of different levels of feed added turmeric (*Curcuma longa*) on the performance of broiler chicks. *J. Agri. Biology Sci.* 1:9-11.

- Eevuri, T.R. and Putturu R. 2013. Use of certain herbal preparations in broiler feeds- A review. Vet. World. 6(3): 172-179.
- HMPC (Committee on Herbal Medicinal Products). 2009. Assessment Report on Curcuma Longa L. Rhizoma. Europe Medicine Agency.
- Emadi M, Kermanshahi H and Maroufyan E 2007. Effect of varying levels of turmeric rhizome powder on some blood parameters of broiler chickens fed corn-soybean meal based diets. Int. J. Poult. Sci. 6: 345-348.
- Kim, H.J., Yokozawat, Kimhy, Tohda, Rao, T.P. and Juneja, L.R. 2005. Influence of Amla (*Emblica officinalis*) on hypercholesterolemia and lipid peroxidation in cholesterol-fed rats. J. Nutr. Sci. Vitaminol. 51:413-418.
- Kumar M, Choudhary R S and Vaishnav J K 2005. Effect of supplemental prebiotic, probiotic and turmeric in diet on the performance of broiler chicks during summer. Indian J. Poult. Sci. 40: 137-141.
- Koul, P., Singh, S., Sharma, R. and Gupta, V. K. (2010) An overview of the ayurvedic medicinal plant Phyllanthus amarus for its botanical, phytochemical and biological explorations. Medicinal Plants: Phytochemistry, Pharmacology and Therapeutics. 1: 315-329.
- Lalla J.K., Hamrapurkar P.D. and Mamania H.M. 2001. Triphalachurna from raw materials to finished products. Indian Drugs 38: 87-94.
- Mehala C. and Moorthy M. 2008. Effects of Aloe vera and Curcuma longa (Turmeric) on carcass characteristics and biochemical parameters of broilers. Int. J. Poult. Sci. 7(9): 857-861.
- Mishra P., Shrivastava V., Verma D., Chauhan O. P. and Rai G. K. 2009. Physiochemical properties of chekiya variety of Amla (*Emblica officinalis*) and effect of different dehydration methods on quality of powder. African J. Food Sci. 3 (10): 303-06
- Mode S. G., Funde S. T.; Waghmare, S. P. and Kolte, A.Y.; (2009). Effect of Herbal Immunodulator on Body weight gain in immunosuppressed broiler birds, Vet. World, Vol. 2(7):269-270.

- Mondal M. A., T. Yeasmin, R. Karim, M. Nurealam Siddiqui, S.M. Raihanun-Nabi, M. A. Sayed and M.N.A. 2015. Siddiky Effect of Dietary Supplementation of Turmeric (*Curcuma Longa*) Powder on the Growth Performance And Carcass Traits of Broiler Chicks. SAARC J. Agri., 13(1):188-199.
- Namagirilakshmi S 2005. Turmeric (*Curcuma longa*) as nutraceutical to improve broiler performance. M.V.Sc., Thesis submitted to Tamil Nadu Veterinary and Animal Sciences University, Chennai.
- Narahari, D., 1992. Performance promoting ability of Active Forte in broilers. Poult. Advisor: 25(7): 37-38.
- Nouzarian R., Tabeidian S.A., Toghyani M., Ghalamari G. and Toghyani M. 2011. Effect of turmeric powder on performance, carcass traits, humoral immune response and serum metabolites in broiler chickens. J. Ani. and Feed Sci., 20, 389-4000.
- Osawa, T., Y. Sugiyama, M. Inayoshi and S. Kawakisi. 1995. Anti-oxidative activity of tetrahydrocurcuminoids. Biotech Biochem. 59: 1609-161.
- Pande C.B. 2000. Zeestress -A promising adaptogenic, antistress and immunomodulatora review. Pasudan 15 (12): 4
- Pervez, Rafiullah and Abdul Sajid 2011. Effect of feed additives on the performance of broilers. ARPN J. Agril. Bio. Sci. Vol. 6:66-71.
- Patel AP, Bhagwat SR, Pawar MM, Prajapati KB, Chauhan HD, Makwana RB 2016. Evaluation of *Emblica officinalis* fruit powder as a growth promoter in commercial broiler chickens, Vet. World, 9(2): 207-210.
- Patil R.G., A.N. Kulkarni, S.S Bhutkar and R.L. Korake 2012. Effect of different feeding levels of *Emblica officinalis* (Amla) on performance of broilers Res. J. Ani. Husb. and Dairy Sci. 3:102-104.
- Prasad A., 2004. Unpublished data, VHL Commercial Farm, Hyderabad.
- Priya, K. T.; Thangavel, A.; Leela, V.; and Kalatharan, J. 2010. Dietary supplementation of amla and grape seed on hormonal status in broiler breeder cocks, Tamilnadu J. Vet. & Ani. Sci. 6 (3) 117-121

- Raghdad A. and Jaleel-AI 2012. Use of turmeric (*Curcuma longa*) on the performance and some physiological traits on the broiler diets. The Iraqi J. Vet. Med. 36(1): 51-57
- Ranade, A. S. and D. N. Desai, 2005. Natural products for enhanced poultry productivity. IPSACON – 2005 available from poultvet.com.
- Rao Mehta and R.G. Nambiar 2015. The poultry industry in India, 1 Senior Fellow, RIS, Zone IV-B, Fourth Floor, India Habitat Centre, Lodhi Road, New Delhi-110 003, India. Email: drmehtarajesh@gmail.com, Professor, Institute of Management, Nirma University, Ahmedabad, Gujarat 382 481, India.
- Reddy R., V. Reddy and K. S. Reddy, 2002. Unpublished data, Nagarjuna Poultry Farm, Shanshabad, Hyderabad.
- Reddy E.T., Reddy P.S., Satyanarayana, P.V.V. Reddy and Shakila S. 2012. Effect of herbal preparations (*Phyllanthus emblica*, *curcuma longa* and *ocimum sanctum*) on the performance of broilers, tamilnadu j. Vet. & Ani. Sci. 8 (4) 209-214.
- Sai Ram M., Neetu D., Deepti P., Vandana M., Ilavazhagan G. and Kumar D. 2001. Cytoprotective activity of Amla (*Embllica officinalis*) against chromic acid (VI) induced oxidative injury in murine macrophages, phytother Res. 17: 430-3.
- Saini A, Sharma S and Chhibber S 2008. Protective efficacy of *Embllica officinalis* against *Klebsiella pneumoniae* induced pneumonia in mice. Indian J. Med. Res. 28: 188-193.
- Samarasinghe K, Wenk C, Silva K F S T and Gunasekara J M D M 2003. Turmeric (*Curcuma longa*) root powder and mannanoligosaccharides as alternatives to antibiotics in broiler chicken diet. Asian-Aust. J. Ani. Sci. 16: 1495-1500.
- Sapkota D and Upadhyaya T N 2009. Efficacy of dietary *Ocimum sanctum* against Aflatoxin B1 in Broilers. Indian Vet. J. 86: 1163-1165.
- Shon K. S., Kwon O.S., Min B.J., Cho H., Chen Y.J., Kim I.H. and Kim H.S., 2002. Unpublished data, Department of animal resources and sciences, Dankook University, Cheonan, Korea.

- Singh S.P. 2007. Production Management of Spices. Agrihortica Pub. Junagadh, Gujarat-362 001.
- Singh, N., Singh, J.P. and Singh, V. (2007) Effect of dietary supplementation of herbal formulation on dressing percentage and mortality in broiler chicks. Indian Journal of Field Veterinarians., 2:22-24.
- Snedecor, G. W. and W. G. Cochran 1994: *Statistical Methods*, 8th edn. IOWA State University Press, Ames, IOWA, USA.
- US Department of Agriculture 2008. *Phyllanthus emblica* information from NPGS/GRIN.
- Vidhyarthi V K, Nring K and Sharma V B 2008. Effect of herbal growth promoters on the performance and economics of rearing broiler chicken. Indian J. Poult. Sci. 43(3): 297-300.
- Wadhwa, D., Sood, S., Meena, K., Sharma V.K. and Chounan, J.S. (2007). Effect of supplementation of gooseberry (*Emblica officinalis*) powder supplementation on biological performance of commercial broilers. XXIV Annu. Conf. of IPSA and National Symposium, 25-27 April, 2007. Ludhiana. p. 95.
- Yagobfar A., Hosseini-Vashan S.J., Golian A., Nassiri M.R. and Raji R. 2011. Evaluation of turmeric powder in diets based soybean oil on performance, energy and protein efficiency ratio and immune system of broiler chickes. Animal nutrition department, Ani. Sci. Research institute, Karaj. Tehrani, Iran, akabaryahobfar@yahoo.com.

7. VITAE



Mr. GYAN CHANDRA
MASTER OF SCIENCE (AGRICULTURE)
IN
ANIMAL HUSBANDRY
2018

Title of thesis		:	“Effect of feeding turmeric and amla on growth performance of broilers.”
Major field		:	Animal Husbandry
Biographical information			
Personal	Date of Birth	:	02/07/1992
	Place of Birth	:	Village- Deenapur, Post- Basila, Tal.- Manikpur, Dist.- Chitrakoot, State- Uttar Pradesh (India) – 210205
	Father’s Name	:	Mr. Nanka Prasad
	Mother’s Name	:	Mrs. Suraj Kali
Educational	Bachelor Degree Obtained	:	B.Sc. (Hons.) Animal Husbandry and Dairying
	Class	:	First class
	Name of University	:	SHIATS Allahabad Uttar Pradesh
Address			
	Email-id	:	gyan.chandra0134@ gmail.com
	Contact Number	:	08896625831



Amla powder



Turmeric powder

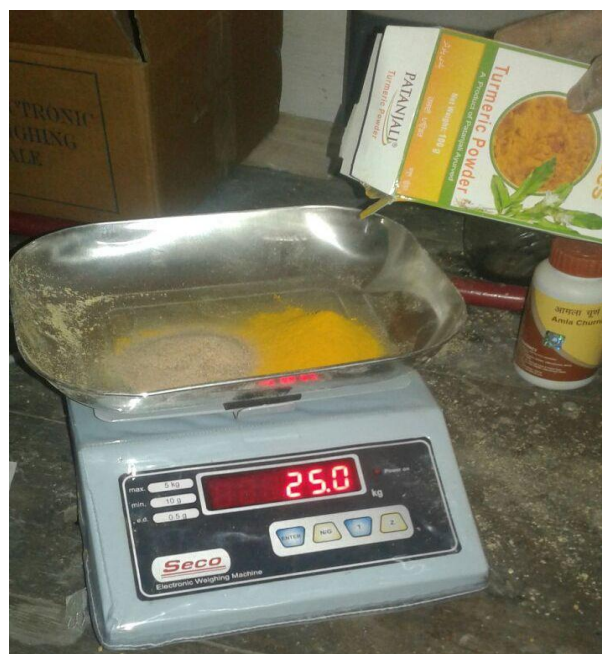


Plate 1. Herbal products, turmeric and amla use for feeding of broilers



Plate 2. Day old chicks and initial body weight



Plate 3. Group wise arrangement of birds under different treatments



1. Cleaning



2. Watering



3. Mixing of feed



4. Feeding

Plate 4. Rearing of birds, daily activity, cleaning, watering, mixing of feed and feeding



Plate 5. Weight of birds at 1st week age



Plate 6. Birds of different age



Plate 7. Weight of birds at 6th week age

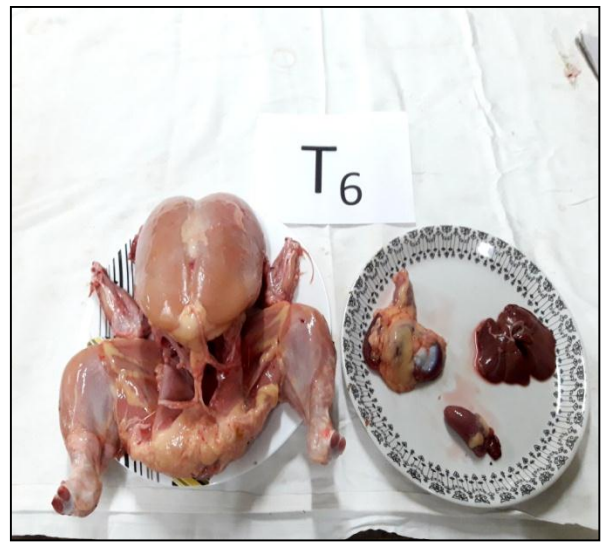
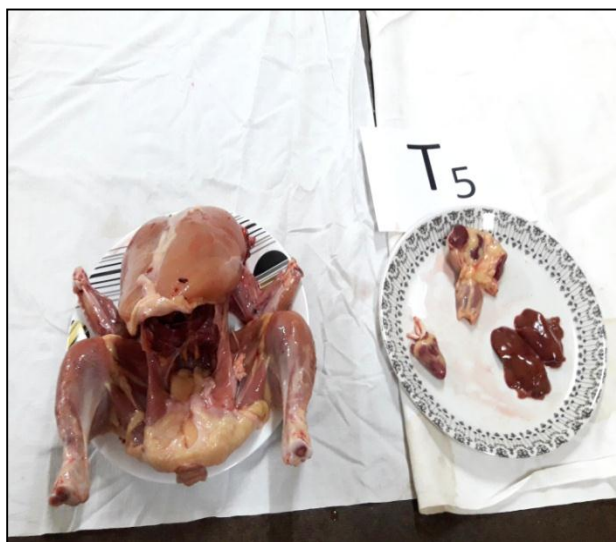
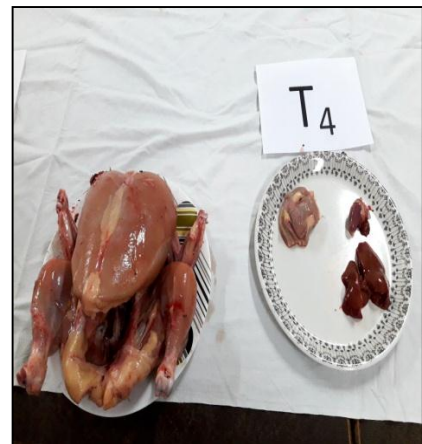
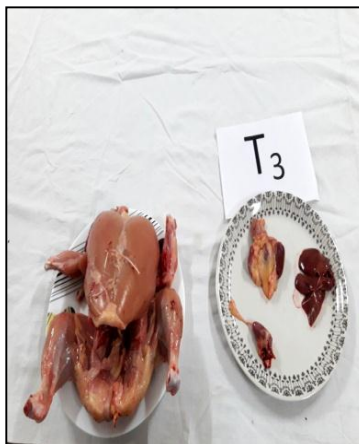
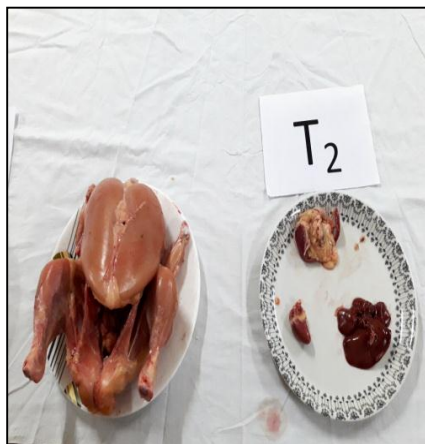
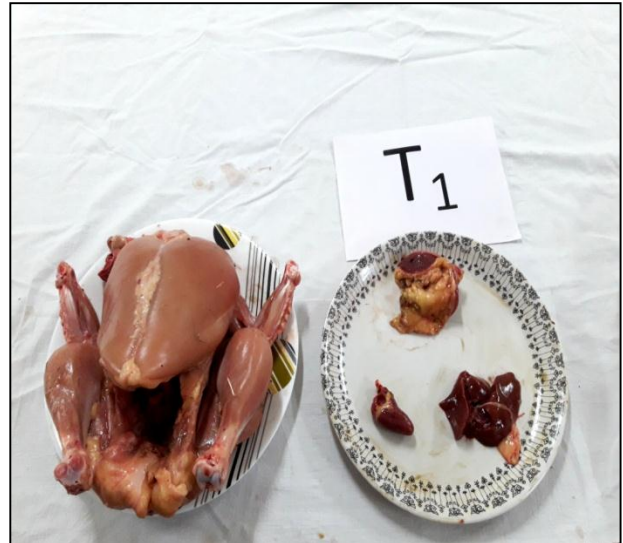
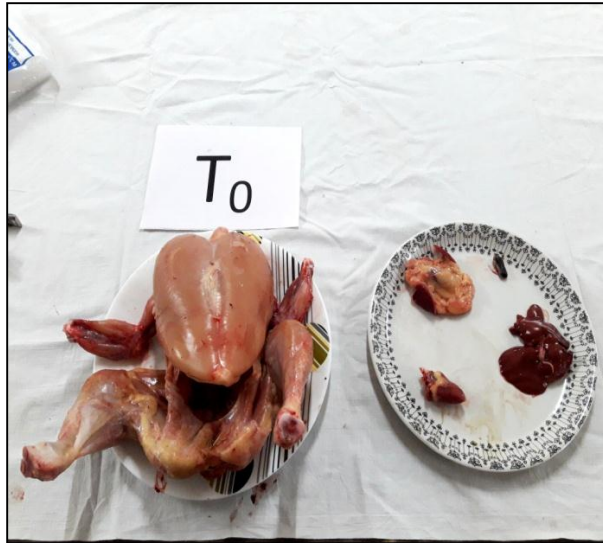


Plate 8. Presentation of meat samples from different treatments



Plate 9. Determination of meat bone ratio

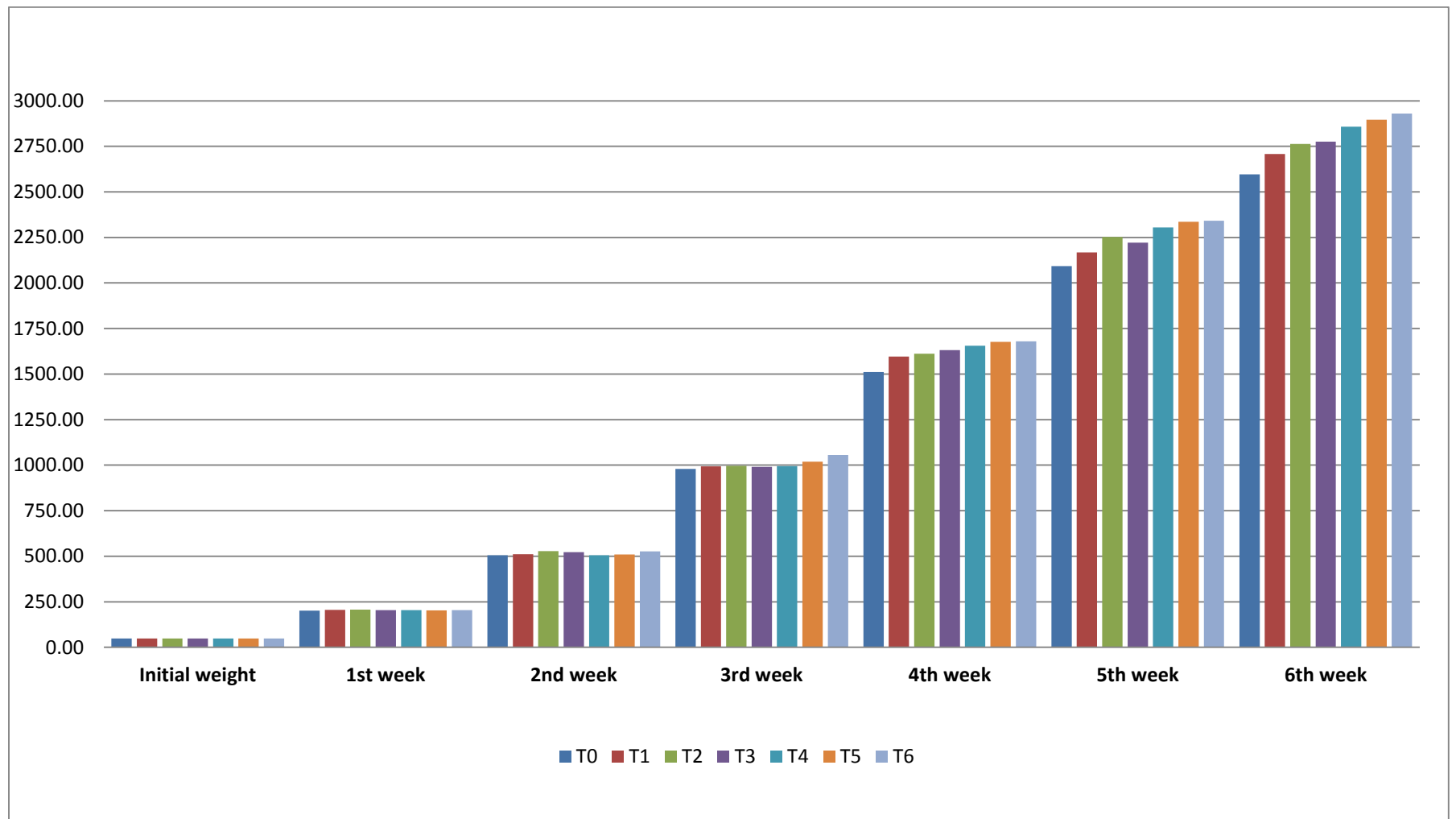


Fig. 1 Effect of turmeric and amla on cumulative average weekly body weight (g) of broilers

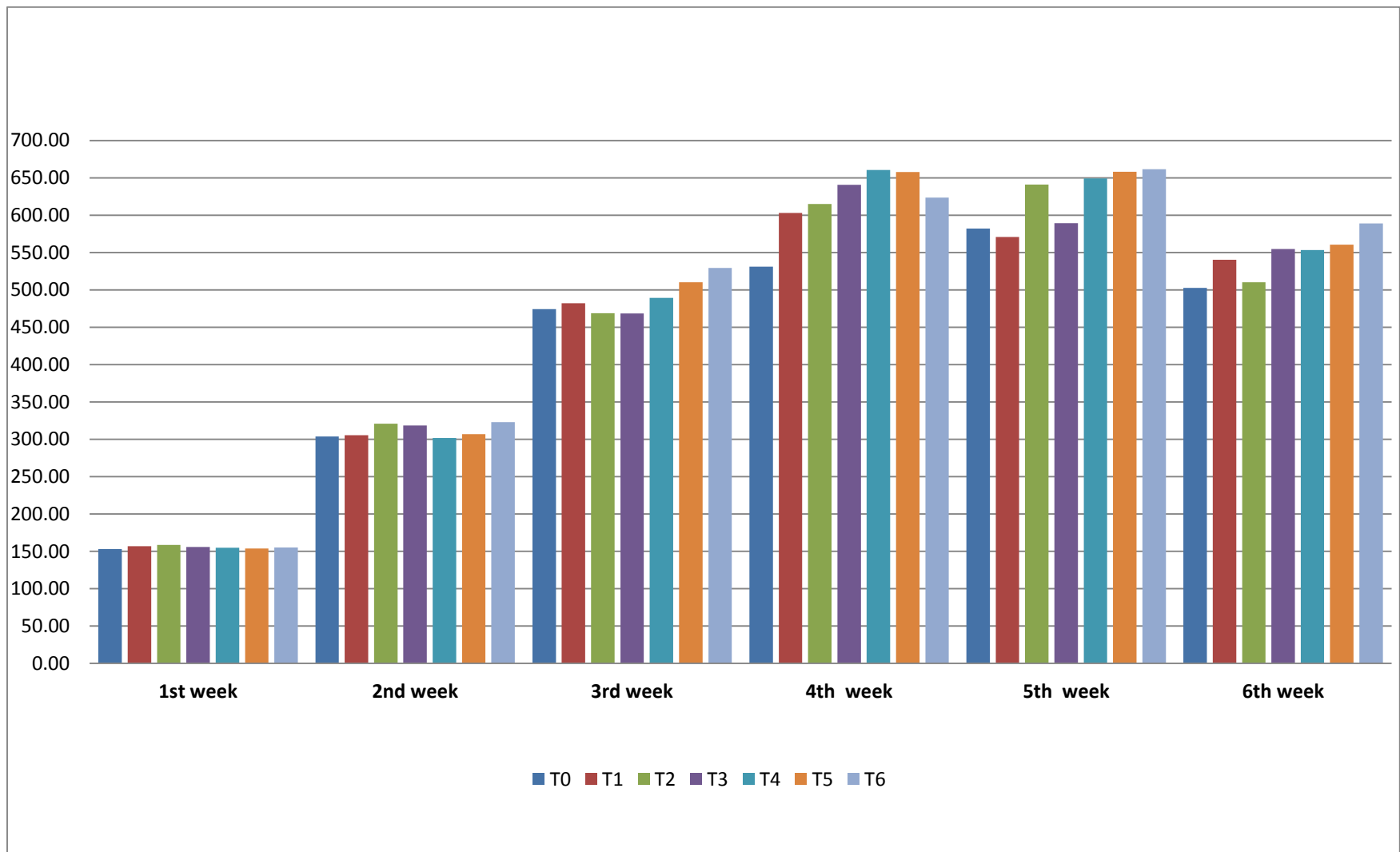


Fig. 2 Effect of turmeric and amla on average weekly body weight (g) gain in broilers

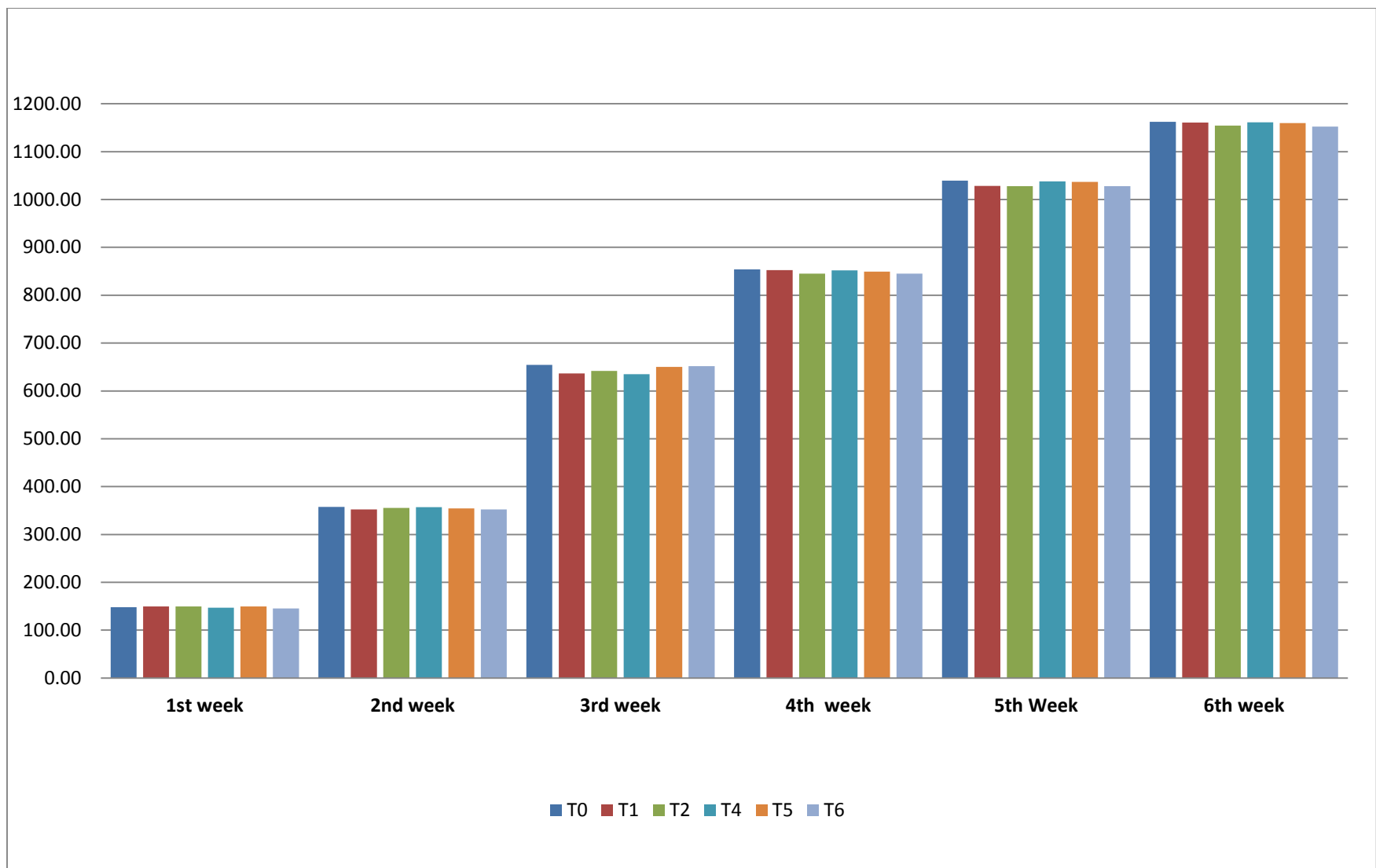


Fig. 3 Effect of turmeric and amla on feed intake (g) in broilers

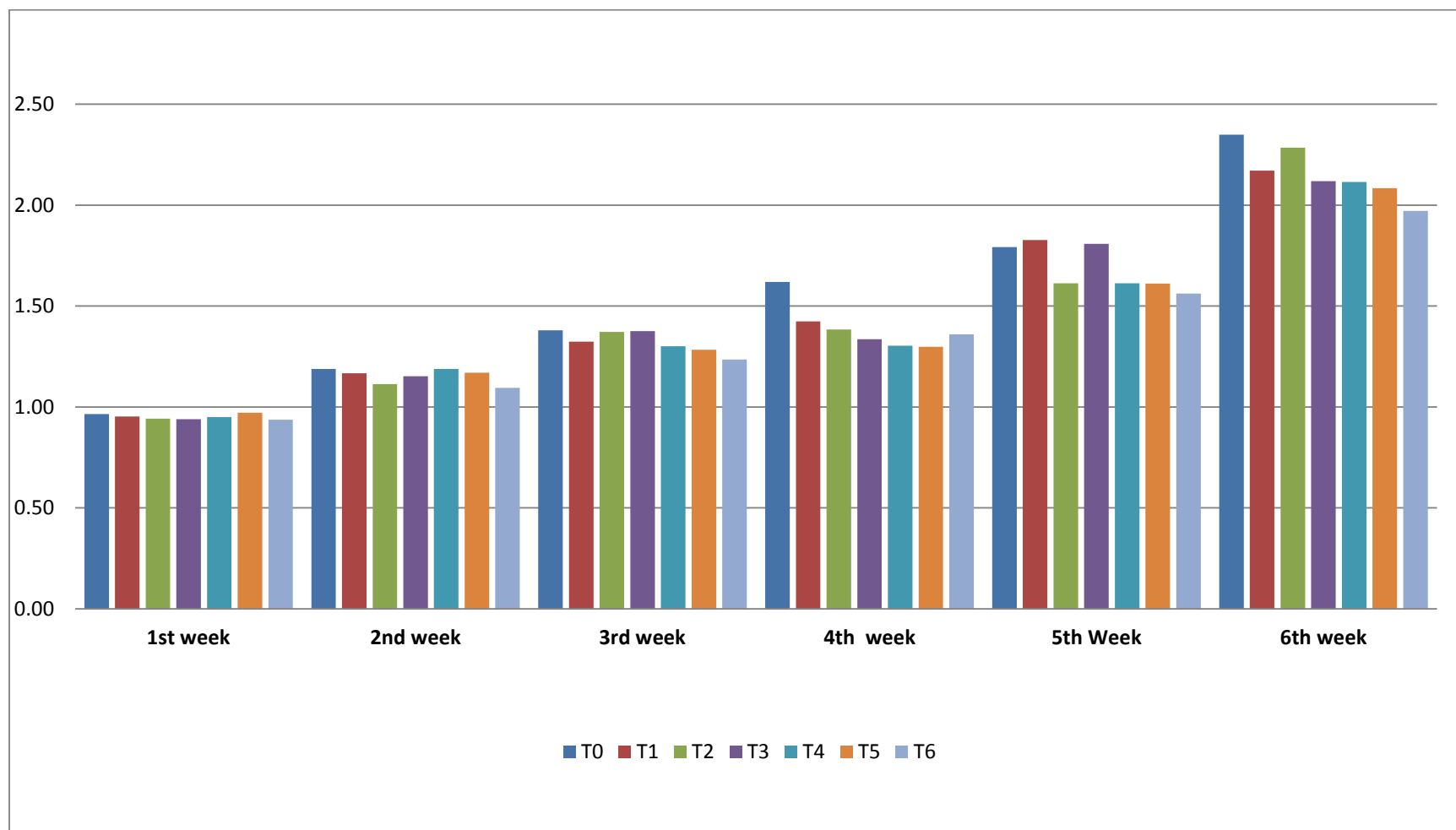


Fig. 4 Effect of turmeric and amla on feed conversion ratio in broilers

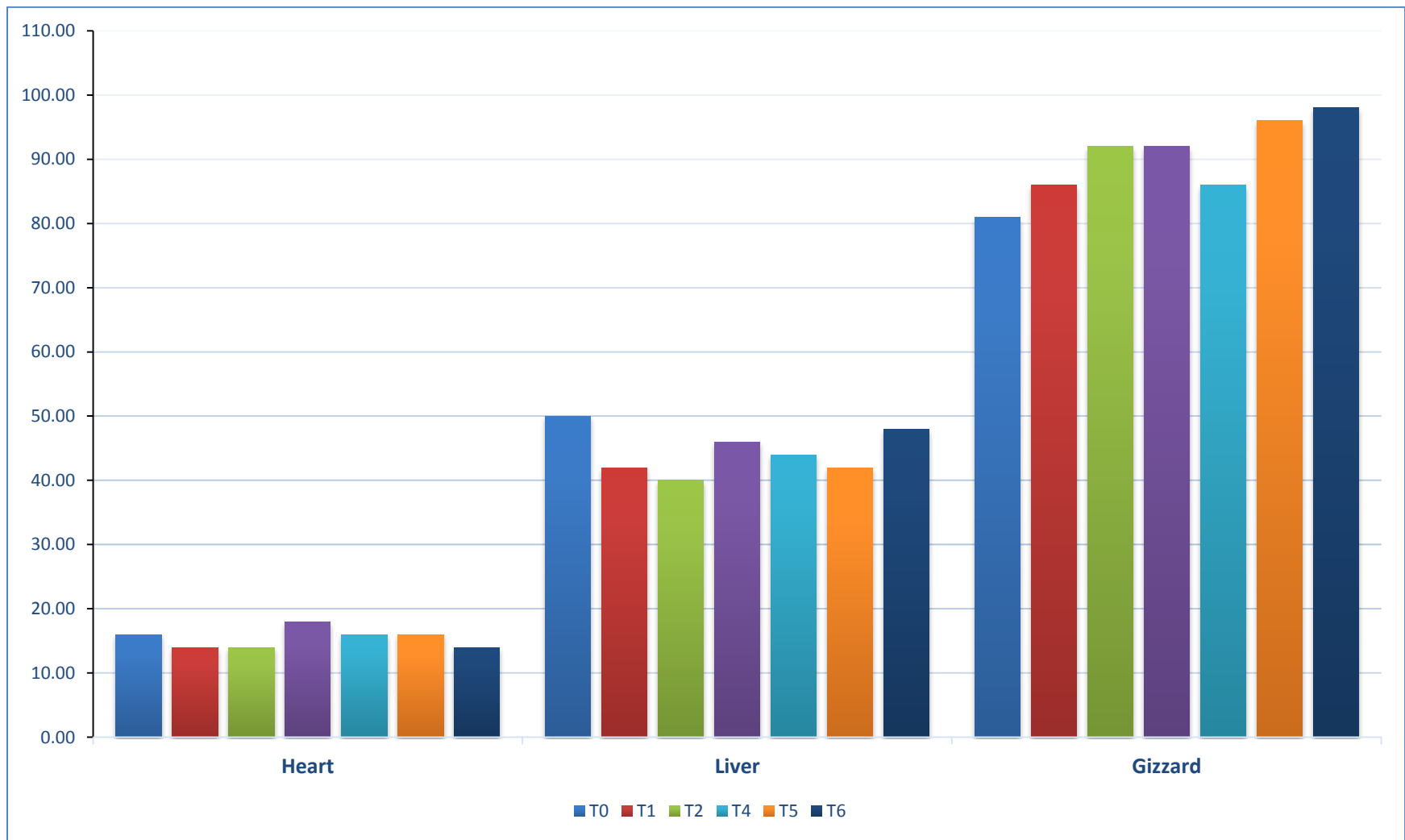


Fig. 5 Effect of turmeric and amla on carcass traits in broilers (live weight basis in gram)

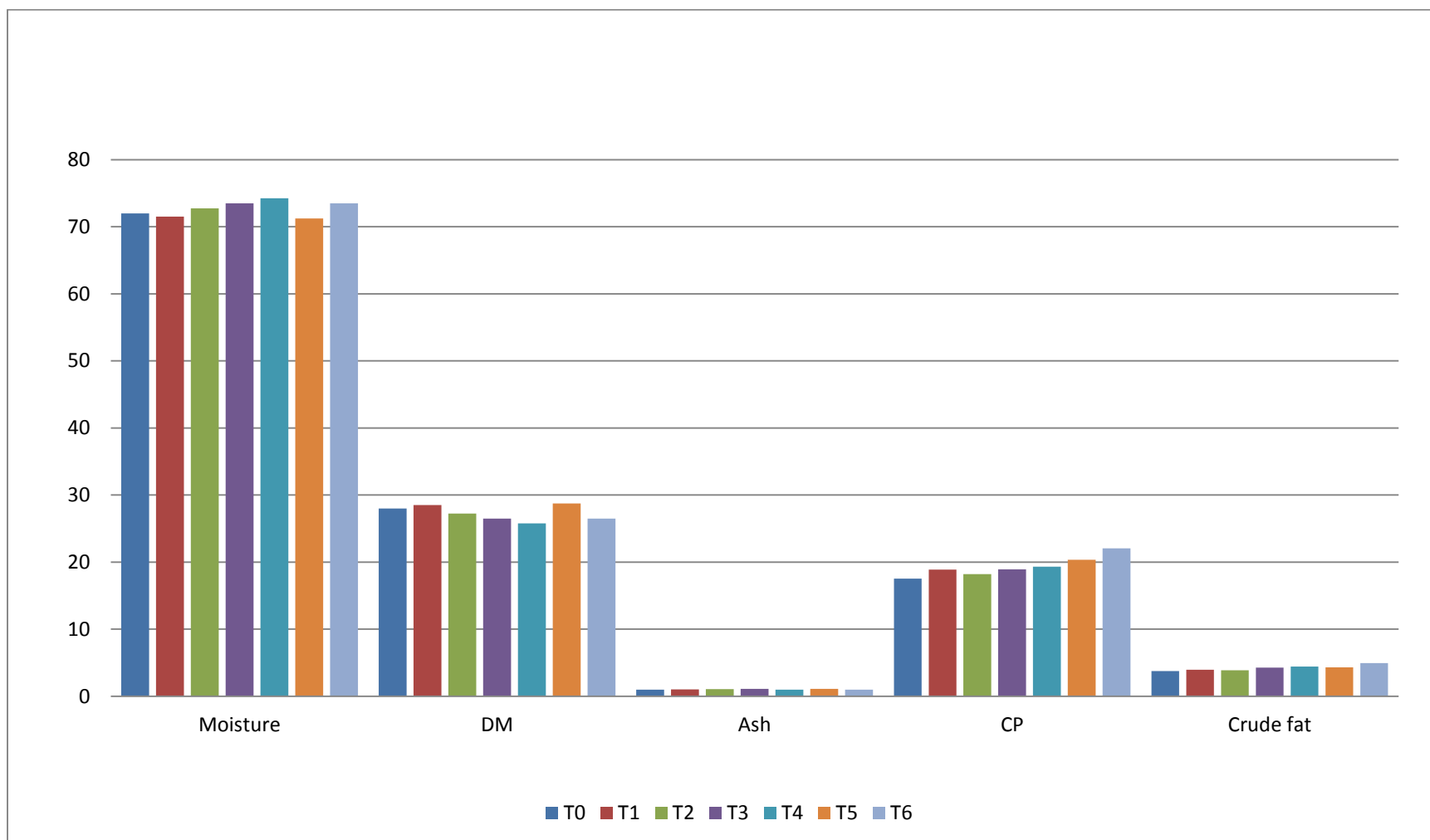


Fig. 6 Effect of turmeric and amla either alone or in combination on proximate composition of meat in different treatments

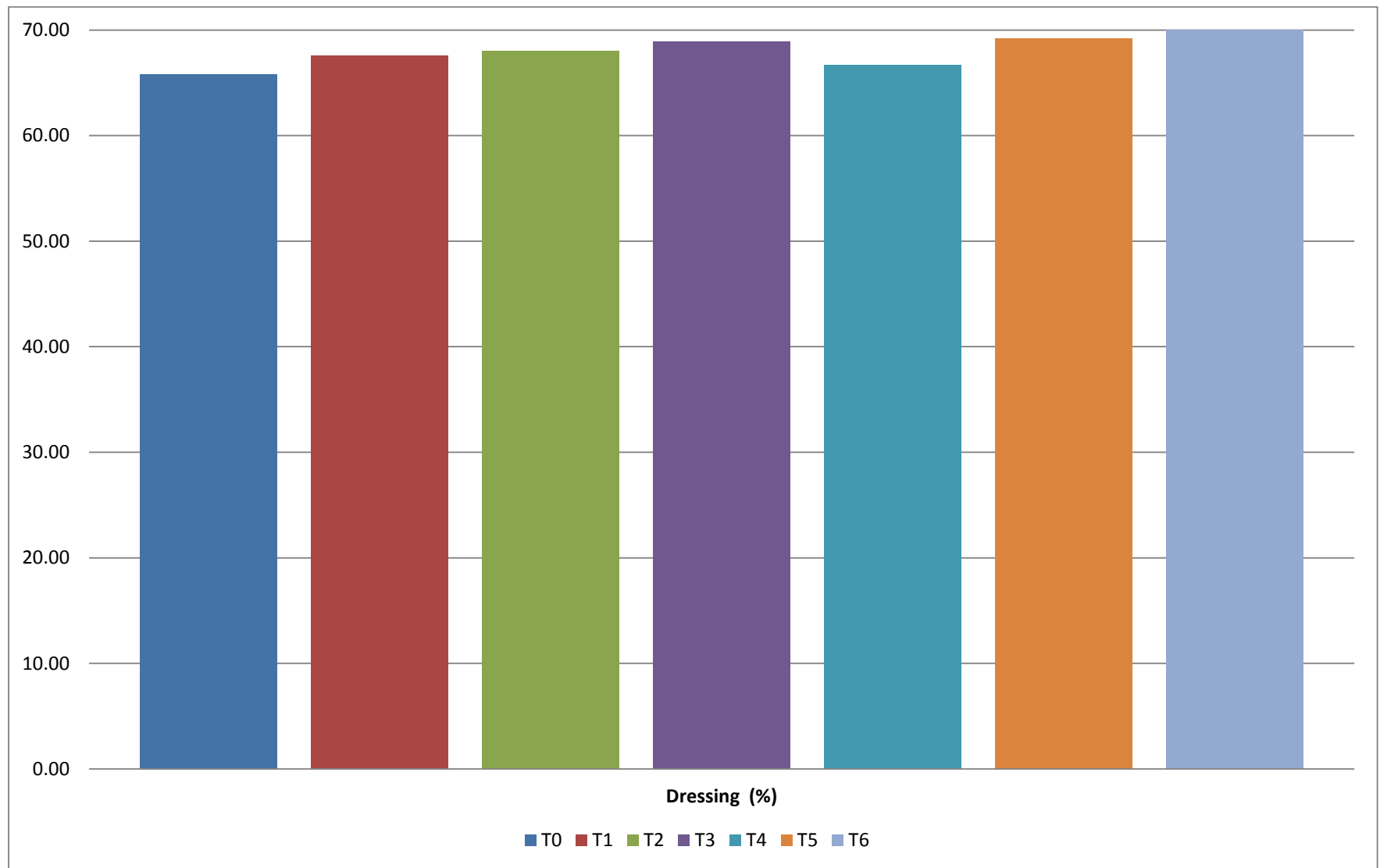


Fig. 7 Effect of Turmeric and Amla on dressing percentage in broilers on live weight basis

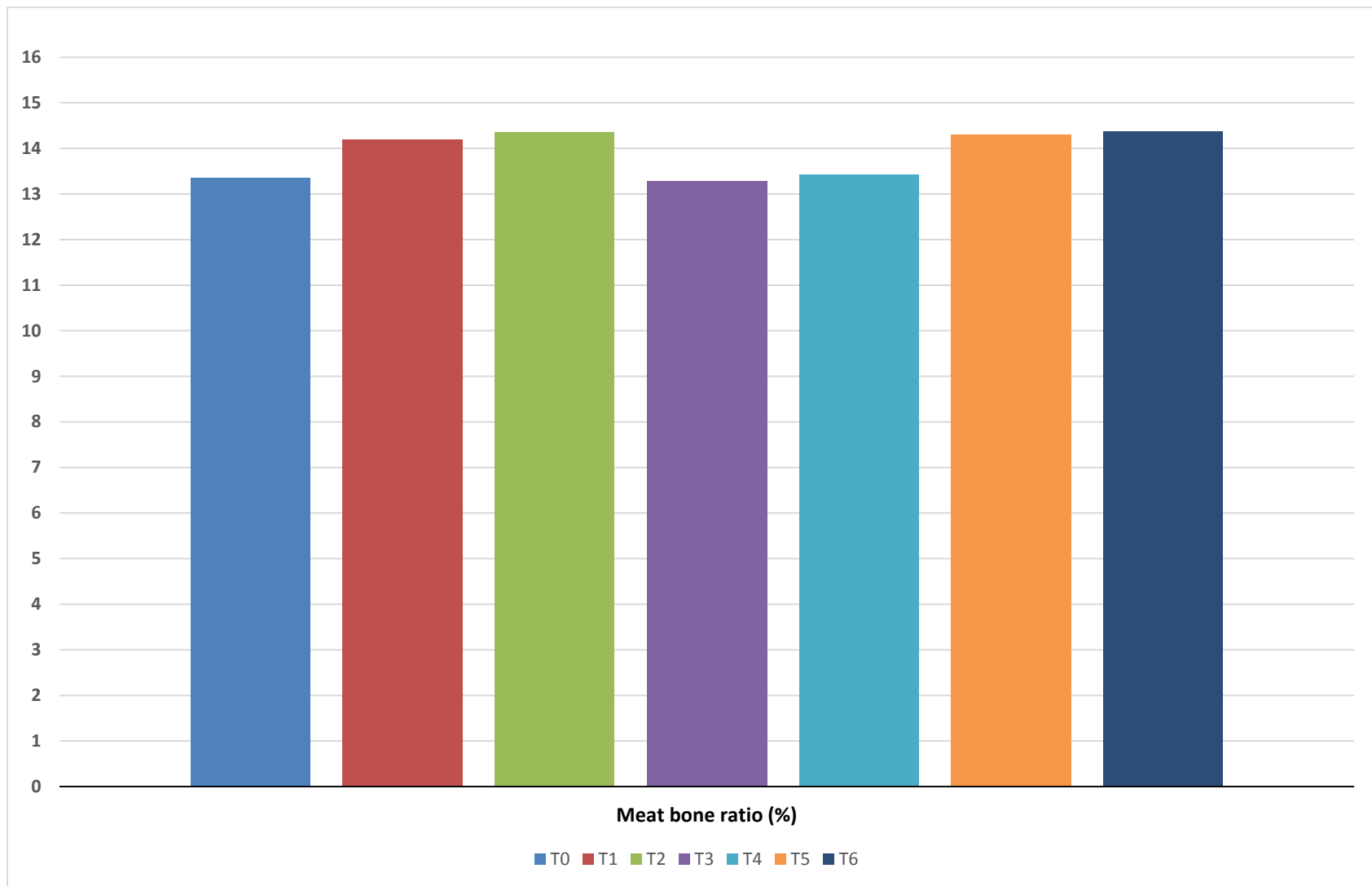


Fig. 8 Effect of Turmeric and Amla on meat bone ratio in broilers on live weight basis