

Effect of *Aloe vera* and clove powder supplementation on growth performance, carcass and blood chemistry of Japanese quails

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ABSTRACT This study was aimed to assess the impacts of aloe vera (**AV**) and clove (**Cv**) powder supplementation on growth performance, carcass quality, blood biochemistry, and hematology of Japanese quails and studying the possibility of using them as alternatives to antibiotics growth promoters as a natural safe products. Four hundred, 7-d old mixed sex chicks were divided into 4 groups of 5 replicates 20 birds per replicate including (10 males and 10 females). Birds in the control group (T1) were fed a diet containing Enramycin (0.02%) as an antibiotic growth promoter (**AGP**), while T2, T3 and T4, birds were supplemented with AV leaf powder, Cv powder and mixture of both at 0.5, 0.5 and 0.25 + 0.25% of feed, respectively. Results showed that total feed intake in all supplemented groups were significantly ($P < 0.05$) higher than T1. Weight gain and feed conversion ratio were significantly higher ($P < 0.05$) in T4 while T2 and T3 were better ($P < 0.05$) than T1.

Breast yield and carcass weight were the highest ($P < 0.05$) in T4 while T2 and T3 were significantly better than T1. High density lipoprotein was highest ($P < 0.05$) in T4 whereas T2 and T3 showed higher value than T1. Blood cholesterol and serum enzymes (ALT, AST and ALP) values were significantly ($P < 0.05$) higher in T1 and lower in T4. The highest hemoglobin level was observed in T4. White blood cells were significantly ($P < 0.05$) higher in T3 and T4. No significant difference was observed in, red blood cells, serum total protein, calcium and phosphorous level, packed cell volume, neutrophils, lymphocyte, monocyte, and eosinophil. It is concluded from this experiment that AV and Cv supplementation improved breast yield and carcass weight without any harmful effect on the liver and blood biochemistry. This showed that the supplementation of AV and Cv powder can improve growth performance and it can work as an alternative of AGP.

Key words: aloe vera, clove, growth and blood parameters, carcass traits, growth performance, quails

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INTRODUCTION

Due to antimicrobial effect of herbal plants and essential oils are becoming more important as an alternative to antibiotic growth promoter (**AGP**) (Abd El-Hack et al., 2020, 2021a,b; El-Tarabily et al., 2021) and their

effect on animal digestive system (Alagawany et al., 2021a, 2021b). Herbal medicines (like AV and Cv) have served as a cheap source of therapy for rural subsistence livestock (El-Shall et al., 2021). They play a very important role in wound healing, inflammation and some medical purposes (Kaur et al., 2019). Acemannan is one of the very significant biologically active compounds (found in AV) which are considered as the main factor for its medicinal properties (Mascolo et al., 2004).

Aloe vera is a very ancient worldwide medicinal plant, its name is originated from Arabic word "Alloeh" which means bright and bitter. Biologically, its name is *Aloe*

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barbadensis Miller. This cactus like plant is native to hot and dried climate. It is grown in almost all continent of world except Antarctica. Due to its rich medicinal and cosmetic uses it is grown in abundant quantity. It is known as “*Gheekwar*” or “*Kawargandal*” in Pakistan. It is mainly grown in province of Sindh in Pakistan (Khan et al., 2016). Due to its biochemical profile AV got more fame in last decade (Christaki and Paneri, 2010). *Aleo vera* have different medicinal applications due to its unique properties as it has antibacterial activity against different pathogenic bacteria, especially Gram-positive bacteria, antiseptic, anti-inflammatory, and immune stimulants effect therefore, it is considered as an excellent substitute of AGP (Suleyman and Sema, 2009; Babak and Nahashon, 2014). The inclusion of AV in poultry feed as a natural supplement can improve poultry productivity and health (Ebrahim et al., 2020).

Clove (*Syzygium aromaticum*) is also a very important herb which has been used as medicinal purposes, food preservative and in cosmetics. Its history starts from Indonesia and now, it is also grown in several parts of the world most abundantly in Brazil. This plant is rich in phenolic compounds (Cortés-Rojas et al., 2014) and due to its chemical composition it has anti-inflammatory, antifungal, antioxidant, anesthetic, antiviral, antidiabetic, and pain reliever effects (Milind and Deepa, 2011).

Due to the world awareness about antibiotic’s drawbacks, several scientists worked on substitute of AGP. The modern substitutes of AGP consist of probiotics (El-Saadony et al., 2021a, b; Alagawany et al., 2021c), prebiotics (Yaqoob et al., 2021), phytogetic compounds (Reda et al., 2021), herbs, plants and their extracts, and sometimes mixture of all of these. The growth enhancer plants as herbs contain many bio-active compounds like mucilage, flavonoids, glycosides, alkaloids, and bitters. Thus, this study was conducted to explore the influence of AV and Cv on growth, carcass, blood chemistry, and in developing Japanese quail.

MATERIALS AND METHODS

Experimental Birds

Research was conducted at College of Agriculture, University of Sargodha, Sargodha. Total duration of this trial was 35 d. For this trial, 400 seven-d old unsexed Japanese quail chicks were collected from a local hatchery. Quails were randomly divided into 4 treatment groups of 5 replicates 20 birds per replicate including (10 males and 10 females). Housing conditions were same for all chicks throughout the experiment. Temperature was kept at 85°F during the first week and then gradually decreased 5°F per week until it was maintained at 75°F throughout the trial.

Housing and Management

The birds were kept in 2 × 2 × 1.5 feet wooden cages in semicontrol quail shed. The house was completely

washed and disinfected before arrival of chicks. Washing was done thoroughly with clean tap water and dried at the end. Disinfection was not done with water only, but after washing it was further disinfected with white wash (mixture of lime stone and phenol). Formalin in water (1:10) was further sprayed over floor of house to disinfect house completely. To avoid any chance of microbial invasion drinker and feeder were washed with clean water and then soaked for an hour into a solution of KMnO₄. After washing and dipping feeder and drinkers were dried and disinfected under hot sun. After drying, utensils were placed into house to further disinfect by fumigation. For fumigation 17.5 g of KMnO₄ and 35 mL of formalin were used and house kept close for 24 h duration to make sure that everything was completely disinfected. At the end, the house was opened to excuse all the poisonous gas. All birds were kept in iso-managerial environment, for example, same temperature, humidity level, light, and space around the clock. Water and feed were available to birds around the clock.

Bio-Security Procedures

This experimental trial was arranged in a fully sanitized and hygienic environment. All the bio-security and preventive measures were completely followed. For further prevention from infectious diseases and microbial invasion, visitors were banned to visit the locality of research area. Washing of drinkers with soap and water was done on a daily basis while feeders were cleaned from feces and feed cakes in order to avoid microbial growth. Foot dip pad was placed on the entrance of the house throughout the research trial to avoid any contamination from feet.

Experimental Diets

The birds were offered starter diet throughout the experimental trial (35 d). The 4 treatments were designed as follows:

Treatment (T) T1: Control group with basal diet with Enramycin; T2: The basal diet supplemented with aloe vera (AV) leaf powder (0.5% of feed offered); T3: The basal diet supplemented with clove powder (0.5% of feed offered) and T4: The basal diet supplemented with AV powder + Clove powder (0.25+0.25 % of feed offered) (Table 1).

Growth Performance

Weekly feed intake (FI) was recorded for each replicate. FI was calculated by subtracting feed refused from weekly feed offered. For all replicate weekly FI was recorded to evaluate the total FI per bird in complete experiment. Body weight gain (BWG): the end of every week all birds were weighed by using an electrical weighing balance. Feed conversion ratio (FCR): By using the above values of FI and BWG, FCR was calculated.

Slaughtering Data

At the end of research 2 birds were selected randomly (male and female) from each replicate and weighed. After taking body measurements (body length, shank length, shank diameter, keel bone length, drum stick length, and breast width) birds were humanly slaughtered following the ethical guidelines of College of Agriculture, University of Sargodha, Sargodha to observe carcass characteristics including dressing percentage, carcass, breast, and thigh weight. Weight of visceral organs including liver, heart, gizzard, and intestine was determined. Carcass weight was taken shortly after slaughtering the birds.

Blood Sampling

Blood from 2 birds (male and female) per replicate was collected by manually slaughtering method at the end of feeding trial. For serum biochemistry and hematology blood samples were put into 2 different labeled test tubes on of these tubes were treated with EDTA and the rest one was plain to separate serum. Blood samples were centrifuged at 3,000 rpm until serum was completely separated and kept in deep freezer for further usage. Different hematological parameters were estimated to study the impacts of the different treatments on blood parameters including white blood cell (WBC) and red blood cells (RBC) total counts, hemoglobin concentration (**Hb**), packed cell volume (**PCV**), blood glucose (**BGL**), total protein (**TP**), and leucocytes differential count (eosinophil, monocyte, lymphocyte, etc.). Serum biochemical indices were blood calcium, blood phosphorous, blood cholesterol, high density lipoprotein (**HDL**), low density lipoprotein (**LDL**) and liver function enzymes including alanine aminotransferase (**ALT**), alkaline phosphatase (**ALP**), and aspartate aminotransferase (**AST**). To determine PCV a spinning of about 5 min were done with 75 μ L blood samples in heparinized capillary tube with a hematocrit centrifuge (Benson et al., 1989). Neubaur chamber method was used to determine erythrocyte and leucocytes (neutrophils, monocytes, eosinophils, and lymphocytes) counts as described by Lamb (1981). The total serum protein was estimated using Biuret method following Reinhold (1953) with the help of commercial kit (Randox Laboratories Ltd, Antrim, UK). The serum calcium and phosphorous were determined using calcium-Berhelot and deproteinization colorimetric methods with the help of commercial kit (Randox Laboratories Ltd, UK). The free cholesterol level was estimated using methods like enzymatic colorimetric and nonane extraction with the aid of the commercial kit (Quimica Clinica Aplicada, SA, Amposta, Spain). Finally, serum enzymes, including ALT, ALP, AST were determined by using commercial test kit of Randox Laboratories, UK.

Blood Cholesterol

The cholesterol level of blood plasma from slaughtered birds was determined by using chemistry analyzer. The

Table 1. Composition of quail basal diet.

Ingredients	%	
Corn	25	
Rice tips	34.19	
Canola meal (37%)	7.7	
Soybean meal (46%)	27.05	
Guar meal	1.0	
Limestone	1.32	
MCP	0.84	
Sodium bicarbonate	0.53	
Vegetable oil	0.71	
DL-Methionine	0.24	
Lysine sulfate 70%	0.33	
Threonine	0.09	
Premix	1.0	
Total	100	
Nutrients %		
	Calculated	Analyzed
ME (kcal/kg)	2,930	
CP	21%	20.85
Dig. Lys	1.15	
Dig. Met + Cys	0.85	
Dig. Thr	0.75	
Dig. Trp	0.23	
Dig. Arg	1.35	
Dig. Isl	0.77	
Dig. Leu	1.45	
Dig. Val	0.87	
Dig. His	0.51	
Dig. Phy	0.86	
CF	2.52	2.62
Ash	5.6	5.90
Ca	0.9	0.93
P total	0.7	0.69
P available	0.45	
Na	0.18	0.19
Cl	0.21	0.22
K	0.72	0.70

analysis was done with the help of a commercial kit with 500 nm wavelength and by using the following formula.

$$\text{Serum cholesterol (mg/dL)} = \frac{\text{Absorbance of sample}}{\text{Absorbance of standard}}$$

Statistical Analysis of the Data

Data collected during this study were statistically analyzed by using Analysis of Variance technique under Complete Randomized Design (**CRD**). The Tukey's test was used to analyze all data (performance, carcass, blood metabolites, immunity, digestive enzymes, antioxidants, and cecal microbiota) whereas ($P < 0.05$) considered as significant differences.

RESULTS

Growth Parameter

A significant ($P < 0.05$) increase in weight gain was observed in T4 while T2 and T3 showed better weight gain than T1 (Table 2). Significantly higher ($P < 0.05$) FI was observed in T1 than all other groups while T2, T3 and T4 represent no difference ($P > 0.05$) among them. Best FCR was observed in T4 which was followed by T2, T3, and T1 (Table 2).

Table 2. Effect of aloe vera and clove powder on growth performance of Japanese quails (7–42 d).

Items	Treatments ¹				SEM	P value
	T1	T2	T3	T4		
Weight gain (g)	181.17 ^c	189.80 ^b	188.41 ^b	193.53 ^a	3.43	0.001
Feed intake (g)	505.41 ^a	487.35 ^b	484.46 ^b	481.94 ^b	8.26	0.009
Feed conversion ratio	2.78 ^c	2.61 ^b	2.57 ^b	2.49 ^a	0.04	0.001

^{a-c}Within a row, means sharing different superscripts differ significantly ($P < 0.05$).

¹T1 consists of control group; T2, T3 and T4 represent inclusion of aloe vera powder (0.5%), clove powder (0.5%), and aloe vera and clove powder (0.25% + 0.25%) in basal diet respectively.

Hematology and Blood Biochemistry

AV and Cv supplementation did not affect ($P > 0.05$) blood total protein, packed cell volume, neutrophil, lymphocyte, monocyte, eosinophil, blood glucose, red blood cells, calcium, and phosphorous (Tables 3 and 4). The significant difference ($P < 0.05$) was observed in white blood cells, hemoglobin, blood cholesterol, and HDL. Hemoglobin was observed higher in T4. Similarly, white blood cells were at the highest level in T4 (Table 3). High density lipoprotein was higher in T4. Low density lipoprotein was significantly ($P < 0.05$) decreased by AV and Cv supplemented diets (Table 3). Low density lipoprotein values were lowest for T4 diet. Similarly, diet T4 showed the lowest blood cholesterol value. Likewise, lower ALT, ALP, and AST levels were observed in T3 and T4 than in T1 and T2 (Table 3).

Carcass Characteristics

Dietary supplementation of AV and Cv did not affect ($P > 0.05$) body length, shank length, shank diameter, keel bone length, drum stick length, breast width and leg quarter yield. However, carcass weight and breast yield were significantly improved by AV and Cv powder (Table 5). Higher carcass weight and breast yield were observed in the group fed T4 diet (Table 5).

Table 3. Effect of aloe vera and clove powder on blood biochemistry of Japanese quails (7–42 d).

Items	Treatments ¹				SEM	P value
	T1	T2	T3	T4		
Total protein (g/dL)	1.98	2.11	2.10	2.30	0.25	0.847
Hemoglobin (g/L)	11.14 ^{ab}	11.09 ^{ab}	11.04 ^b	11.68 ^a	0.16	0.028
Phosphorus (mg/dL)	5.00	5.05	4.95	4.96	0.09	0.647
Calcium (mg/dL)	10.96	10.98	10.90	10.91	0.054	0.683
Cholesterol (mg/dl)	140.60 ^a	140.50 ^a	138.50 ^b	136.90 ^c	1.39	0.001
LDL (mg/dL) ²	20.70 ^a	18.30 ^b	18.30 ^b	17.92 ^b	1.48	0.001
HDL (mg/dL) ²	111.04 ^b	112.22 ^{ab}	112.35 ^{ab}	113.32 ^a	1.55	0.049
ALT (μ kat/L) ²	35.49 ^a	34.61 ^a	33.01 ^b	32.61 ^b	1.33	0.049
ALP (μ kat/L) ²	1048.10 ^{ab}	1048.90 ^a	1047.20 ^b	1046.80 ^b	1.37	0.019
AST (μ kat/L) ²	117.32 ^a	116.53 ^a	114.39 ^b	114.10 ^b	1.35	0.004

$P > 0.05$ = nonsignificant; $P < 0.05$ = significant.

^{a-c}Within a row, means sharing different superscripts differ significantly ($P < 0.05$).

¹T1 consists of control group; T2, T3 and T4 represent inclusion of aloe vera powder (0.5%), clove powder (0.5%), and aloe vera and clove powder (0.25% + 0.25%) in basal diet respectively.

²LDL: low density lipoprotein; HDL: high density lipoprotein; ALT: alanine aminotransferase; ALP: alkaline phosphatase; AST: aspartate aminotransferase.

Organs and Offal

Data represented in Table 6 shows the effect of supplementation of AV and Cv powder on giblets and offal of quails. All the treatment showed no effect on liver, heart and gizzard weight. However, intestinal length, intestinal weight, fat, and fat percentage were significantly improved ($P < 0.05$). Intestinal length and weight were significantly higher in T4 while fat and fat percentages were observed lower in T4 which was followed by T3, T2, and T1 (Table 6).

DISCUSSION

Feed Intake

From our findings, we wined up that the dietary addition of AV and Cv resulted in significant improvement in feed intake. Similar findings have been reported by Nghonjuyi et al. (2015), Tariq et al. (2015), and Nalge et al. (2017). Also, Fallah (2015) reported that adding AV (1.5%) in drinking water cause higher feed intake. Darabighane et al. (2012) pointed out increased feed intake when using 2% AV gel in the feed for broiler chicks. Ebrahim et al. (2020) augmented the feed intake improvement in AV-treated birds to the change in taste, stimulation of the appetite, and improved secretions of pancreatic and digestive enzymes. Dalkiliç and Güler (2009) observed that addition of Cv extract (400 g/kg) can be used an alternative of AGP in feed of broiler improved the feed intake. Mukhtar (2011) displayed an increase in the feed intake by chicks fed Cv oil (600 mg/kg) compared with those from the control group. Ao, found that feed intake was gradually augmented with an increase in Cv oil level (Hussein et al., 2019). Mansoub (2011) observed a significantly higher digestibility and absorption of amino acids when herbal plants were added in birds feed, and reported that herbal mixture improve pancreatic and digestive enzymes secretion thus cause higher absorption of nutrients. The improvement in feed intake which associated with the usage of AV and Cv dietary supplementation could be

Table 4. Effect of aloe vera and clove powder on hematology of Japanese quails (7–42 d).

Items	Treatments ¹				SEM	P value
	T1	T2	T3	T4		
RBC (trillion cells/L) ²	3.59	3.58	3.59	3.51	0.05	0.063
Glucose (mmol/L)	98.00	97.50	97.50	98.20	1.68	0.868
WBC (cells/L) ²	3.24 ^b	3.25 ^b	3.30 ^{ab}	3.32 ^a	0.03	0.009
Packed cell volume%	40.70	40.60	40.60	40.80	0.28	0.952
Neutrophil %	2.36	2.56	2.36	2.47	0.16	0.788
Lymphocyte %	91.50	90.60	91.40	90.40	0.32	0.540
Monocyte %	2.29	2.09	2.30	2.13	0.16	0.726
Eosinophil %	2.49	2.40	2.29	2.19	0.16	0.590

$P > 0.05$ = nonsignificant; $P < 0.05$ = significant.

^{a-c}Within a row, means sharing different superscripts differ significantly ($P < 0.05$).

¹T1 consists of control group; T2, T3 and T4 represent inclusion of aloe vera powder (0.5%), clove powder (0.5%), and aloe vera and clove powder (0.25% + 0.25%) in basal diet respectively.

²RBC: red blood cells; WBC: white blood cells.

contributed to their antimicrobial activity, improved appetite, increased pancreatic and digestive enzymes secretions, improved digestibility, and improved intestinal absorptability (Yang et al., 2009).

Contrarily, Odo et al. (2010) and Aroche et al. (2018) reported that decreased feed intake in poultry birds when fed AV supplemented diets. Mustafa (2016) and Cabuk et al. (2014) observed no prominent effect on feed intake when herbal mixture and Cv extract respectively were supplemented to broiler and Japanese quail. Mustafa (2016) reported that feed intake was decreased by raising the level of Cv in broiler chicks. This adverse reduction in feed intake could be contributed to better availability of nutrient and improvement in nutrients absorption in intestine of bird and they eat only for satisfaction of energy need (Ferket and Ger-nat 2006) so early satisfaction for energy is obtained

Table 5. Effect of aloe vera and clove powder on carcass quality of Japanese quails (7–42 d).

Items	Treatments ¹				SEM	P value
	T1	T2	T3	T4		
Body length (cm)	30.8	30.9	31	31.1	1.54	0.506
Shank length (cm)	3.84	3.92	3.94	3.90	0.05	0.520
Shank diameter (cm)	1.81	1.82	1.83	1.83	0.05	0.990
Keel bone length (cm)	6.63	6.61	6.63	6.63	0.10	0.997
Drum stick length (cm)	5.70	5.67	5.67	5.70	0.17	0.796
Breast width (cm)	3.88	3.88	4.04	4.00	0.19	0.498
Breast yield (g)	90.40 ^b	95.60 ^{ab}	97.10 ^{ab}	100.10 ^a	1.98	0.002
Leg quarter yield (g)	50.60	52.00	53.40	54.80	1.18	0.092
Carcass weight (g)	145.0 ^b	151.6 ^{ab}	154.5 ^{ab}	158.9 ^a	2.51	0.003

$P > 0.05$ = nonsignificant; $P < 0.05$ = significant.

^{a-c}Within a row, means sharing different superscripts differ significantly ($P < 0.05$).

¹T1 consists of control group; T2, T3 and T4 represent inclusion of aloe vera powder (0.5%), clove powder (0.5%), and aloe vera and clove powder (0.25% + 0.25%) in basal diet respectively.

Table 6. Effect of aloe vera and clove powder on giblets and offal of Japanese quails (7–42 d).

Items	Treatments ¹				SEM	P value
	T1	T2	T3	T4		
Intestine length (cm)	70.00 ^b	72.00 ^{ab}	73.10 ^{ab}	75.30 ^a	1.88	0.002
Intestine weight (g)	9.88 ^c	10.96 ^{bc}	11.53 ^{ab}	12.50 ^a	1.36	0.001
Liver (g)	5.19	5.16	5.16	5.17	0.14	0.899
Heart (g)	1.93	1.92	1.95	1.94	0.08	0.994
Gizzard (g)	3.40	3.42	3.44	3.44	0.13	0.796
Fat (g)	2.20 ^a	2.10 ^a	1.96 ^{ab}	1.69 ^b	0.08	0.002
Fat percentage (%)	1.01 ^a	0.95 ^a	0.89 ^{ab}	0.74 ^b	0.04	0.003

$P > 0.05$ = nonsignificant; $P < 0.05$ = significant.

^{a-c}Within a row, means sharing different superscripts differ significantly ($P < 0.05$).

¹T1 consists of control group; T2, T3 and T4 represent inclusion of aloe vera powder (0.5%), clove powder (0.5%), and aloe vera and clove powder (0.25% + 0.25%) in basal diet respectively.

due to better utilization of feed. Increased number of epithelial cell mass might be the reason of improved absorption in intestine of chicks (Engberg et al. 2002; Batool et al., 2021).

Weight Gain

Findings of the current study were parallel to the findings of Nghonjuyi et al. (2015), Fallah (2015), and Nalge et al. (2017) who found that addition of gel or powder in feed improved body weight gain of chicks. Darabighane et al. (2011) reported that largest height of villus when 2% of AV gel was supplemented to broiler birds and reported higher weight gain. This finding may be contributed to ability of AV maintain the gut micro flora which resulted in increased nutrient absorption and improved weight gain (Odo et al., 2010; Nalge et al., 2017). In addition to, aloe vera forms a protective film on the mucous epithelia of the gastro-intestinal tract against infections and toxins (Nalge et al., 2017) as well as, the main active principal in AV is acemannan polysaccharide which is responsible for the improved body weight gain in groups supplemented due to its antibacterial properties and immune stimulant effect (Nalge et al., 2017).

Clove seed is also used as a growth promoter. It improves weight gain in broilers (Mustafa, 2016). Ertas et al. (2005) observed significantly higher weight gain in broiler chickens when 200 ppm essential oils (including Cv oil) were supplemented to broiler chicken. Tariq et al. (2015) also observed that use of both AV and Cv improved body weight gain of birds. Mehr et al. (2014) stated that BWG was significantly enhanced in broilers fed Cv essential oil (450 ppm). Also, quails fed with Cv oil (1.5 mL/kg diet) showed 3.43% improvement in BW compared with the control group (Hussein et al., 2019). This effect was explained by Kaur et al. (2019) as they found Cv buds contain the high values from saponin (Chaudhary et al., 2018). Changkang et al. (2007) reported that 600 mg water extract of AV gel results in high is weight gain during third and sixth weeks. Mmereole (2011) found that BWG was significantly augmented in broiler chickens

fed diets containing 1% AV powder. Lee and Shibamoto (2002) observed reduced population of pathological microbes by using herbs and they also reported reduction in degradation of amino acid so, it improves weight gain which might be due to availability of more amino acids. Thus, in the present study combined effect of AV and Cv resulted in better weight gain of quails.

The findings of this study were contradictory with the results of Mustafa (2016) and Lee et al. (2003) who reported that no effect of Cv powder and essential oil addition in feed on weight gain in broilers. Darabighane et al. (2017) observed that there was no effect of AV on protein production and weight gain in broiler. No effect of AV on weight gain might be due to inclusion of less amount of AV in diet which was inadequate to affect growth.

Feed Conversion Ratio

Results of this study are in similar to the findings of Nghonjuyi et al. (2015), Fallah (2015), and Odo et al. (2010) who observed that FCR was significantly improved by supplementing varying levels of AV gel and powder in broiler feed. Also, Tariq et al. (2015) observed improved FCR in a group having AV and Cv mixture as compared with basal group. Many scientists observed positive impact of Cv on broilers performance and they observed improved FCR (Bozkurt et al., 2012a; Cabuk et al., 2014)

Clove powder and its extracts have good antibacterial, antiviral, antiparasitic and antifungal properties (Kim et al., 2004). The improvement in FCR could be due to the helpful effects of dynamic ingredient such as eugenol, which has ability to stimulate the digestive system (Ghanima et al., 2020). Besides eugenol, Cv is rich in many trace minerals like manganese which are necessary for metabolism and creation of carbohydrates, fatty acids and amino acids; it also contains vitamins (C and K) and omega 3 (Alcicek et al., 2003). The improvement in FCR could be due to its effective ingredient profile.

The improvement in the productive performance of poultry fed AV may be due to the phenolic components contain anthraquinones that improve absorption of nutrients from the intestine and are strong antibacterial agents (Ebrahim et al., 2020). Higher nutrient absorption in AV supplemented diets resulted in better body weight leading to improved FCR (Fallah, 2015). Aloe vera might have improved absorption of nutrients in feed and stabilized the gut micro flora. Therefore, better FCR is obtained with significant increase in weight gain but birds do not consume more feed (Odo et al., 2010). Tariq et al. (2015) also stated that digestibility and amino acid absorption significantly increased by using herbal plants. It was also reported that digestive enzymes and pancreatic secretion were stimulated and increased by herbal plants which resulted in higher absorption of nutrients. Acemannan a mannose polymer which is found in AV and eugenol in Cv could be the reason of the improved FCR (Reynolds and Dweck, 1999).

The population of beneficial microbes, for example, lactobacillus was increased (Darabighane et al., 2011; Agostini et al., 2012) and harmful specie population like *E. coli* was decreased when AV and Cv were supplemented to birds (Ordonez et al., 2008). The decreased pathogenic load could be caused by binding of mannose-specific Type 1 fimbriae of pathogens with mannan oligosaccharide (from AV) which ultimately stopped the colonization of pathogens at epithelia of intestine (Spring et al., 2000). The improved intestinal health and gut microflora cause more nutrients absorption and utilization which cause high growth performance and good FCR (Patel and Sharma, 2013).

Results of present study are contradictory to Fallah (2015) and Nalge et al. (2017) who reported that dietary AV and Cv showed no improvement in FCR when supplemented in broiler ration. Hernández et al. (2010) also found that Cv had no effect on FCR. Aroche et al. (2018) observed reduction in FCR when 0.5% mixture of medicinal herbs was supplemented to broiler, the reduction in FCR could be due to low feed intake. Odo et al. (2010) reported that increasing level of AV causes purgative effect thus resultantly causes low FCR. These variations may be contributed to the level of AV and/or Cv inclusion with the basal diet, the time period of its administration, the general health status of tested birds, presence of stressor factors, experimental, and environmental conditions.

Carcass Quality

Numeric outcome of current study are in line with the results of Tariq et al., (2015) and Mehala and Moorthy (2008) who reported that breast and dressing yield were affected by the supplementation of AV and Cv powder in Japanese quail diets. In another study Fallah (2015) reported that carcass weight was improved by using AV and garlic powder in broiler feed. Similarly, Cabuk et al. (2014) found that adding of Cv oil in feed of Japanese quails significantly improved the carcass characteristics of birds. Hernández et al. (2010) observed higher neck, thigh, wing, carcass, liver and breast weights in a group fed Cv essential oil and antibiotic. Suliman et al. (2021) stated that broiler chickens fortified with Cv seeds (1, 2, 3, 4, 5, and 6%) did not significantly affect the body composition and carcass characteristics. Mansoub (2011) found that herbal plants cause good effect on carcass quality by higher absorption of amino acid, nutrient utilization and improved protein metabolism which result in higher percentage of breast yield and carcass weight. It could be attributed to the antioxidant properties of Cv that inhibited lipid oxidation of carcass that is known to be the key reason behind meat quality spoiling resulting in rancidity and creation of unacceptable flavors and odors (Amaral et al., 2018).

Numeric outcomes of current study are contradictory with the results of Islam et al. (2017) who stated that carcass yield increased and breast weight was not

affected by supplementation of AV gel and powder in broilers diet. Parallel results were observed by other researchers (Tariq et al., 2015; Hernández et al., 2010) who used AV and Cv in broilers diet. Borazjanizadeh et al. (2011) also observed addition of Cv and oregano 1% in feed decreased dressing percentage. These results disagreed with present study because level of Cv was higher in these studies which might cause reduction in growth (Cabuk et al., 2014).

Relative Organ Weight

The results of current study are shored up by Mehala and Moorthy (2008), Tariq et al. (2015), and Fallah (2015) who concluded that gut length, gizzard weight, liver weight and heart weight were not changed by the addition of AV gel or powder in quail and broiler diet or drinking water. Moreover, the studies of Tariq et al. (2015), Mustafa (2016), Cabuk et al. (2014), and Hernández et al. (2010) agree with our study who concluded that gizzard weight, liver weight and heart weight remained unchanged in birds fed Cv powder or oil in birds diet. Bozkurt et al. (2012a) concluded that addition of 1 and 2% Cv in diet did not affect liver, gizzards and abdominal fat weight. However, Suliman et al. (2021) found that the high level of Cv seed supplemented within broiler diets up to 6% significantly augmented internal organ weight (gizzard, heart, and liver) of broiler chicks. The results are opposing to the results Kim et al. (2016) who reported significantly increased relative organ weight of bursa of fabricius with 2 different essential oils including Cv oil.

Blood Biochemistry and Hematology

The results of present study are in agreement with the findings of Tariq et al. (2014), Babak and Nahashon (2014), and Fallah (2015) who reported that blood calcium, phosphorous, and glucose were not affected by AV and its Cv in broiler and quails ration. Other researchers Valle-Paraso et al. (2005) also reported similar results when AV was supplemented in broiler and layers and quail diets.

Our results about hematology are in concordant with the findings of Tariq et al. (2014) who found that white blood cells were improved and red blood cells and were not improved by AV and Cv powder supplementation in Japanese quail diet. Change in white blood cell count is in harmony with the study Valle-Paraso et al. (2005) who reported that white blood cell was increased in broiler blood. Reduction in blood cholesterol and lipids might be due to decrease in microbial intracellular pH (Babak and Nahashon, 2014). They caused an increase in the production of WBC and simulated the immune system by decreasing microbial load, disease stress and increased cell production (Nalge et al., 2017). According to Bozkurt et al. (2012b), AV has a nutraceutical property that enhances the activity of neutrophil production and causes decrease in pathogenic activity which

resultantly reduces mortality during severe infection. As the acemannan (polysaccharide) present in AV and eugenol as a potential ingredient present in Cv, these compounds are considered as a natural antibiotics, antiviral and antiseptic agents (Reynolds and Dweck, 1999; Babak and Nahashon, 2014).

The results of present study about blood cholesterol, HDL, and LDL are similar to Rajasekaran et al. (2006) who orally supplemented AV gel extract (300 mg/kg body weight per day) to induced diabetic rates and observed a significant increase in HDL and decrease in LDL cholesterol. Similarly, Emadi and Kerman-shahi (2006) reported significantly reduced blood cholesterol, low LDL and high HDL at 42 d old male broiler chicken treated with turmeric rhizome powder. Conflictingly, Tariq et al. (2014) and Singh et al. (2013) reported no significant difference in blood cholesterol, HDL and LDL when AV and Cv were supplemented to broiler and quails. The result of this study are further contradictory with the results of Hashemi and Davoodi (2012).

The numeric values related to liver function enzymes (ALT, AST and ALP) of resent study showed no significant difference between all experimental treatments and control group because these enzymes are related to liver stress, the level of these enzymes are more when there is stress of toxicity on liver due to any disease or medicine (Lumeij and Westerhof, 1987). This shows that there is no harmful effect of herbal growth promoter on liver function. Fallah (2015) indicated that the serum activity of ALP, AST and ALT were declined in broiler chicken treated with AV gel (1.5 or 3.0%) in the drinking water, compared with a control. Sinha et al. (2017) reported that AV extract (2, 5 or 7 g/kg diet) supplementation in the bird diet lessened the lipid peroxidation, augmented the antioxidant status and provided protection to the liver and kidney. Mustafa (2016) clarified that ALP activity was slightly declined in broiler chickens fed Cv (600 mg/kg) compared with that of the control group. Thus, the Cv and AV supplementation did not have a detrimental effect in poultry. Dietary supplementation with Cv and AV could be a safe alternative to antibiotics as growth promoters and have numerous beneficial effects on bird health and performance.

The results revealed that T1 including Enramycin revealed the significant lower feed intake, weight gain and feed conversion ratio, breast yield, carcass weight, and high density lipoprotein level while blood cholesterol and serum enzymes (ALT, AST, and ALP) were significant increased in T1 in comparison with other groups. These results were in concur with ElSheikh et al., (2019) as the found the enramycin caused a significant ($P < 0.05$) adverse impacts on the liver function enzymes as compared to symbiotic treated broiler chickens.

CONCLUSION

All of these findings from the current study showed that dietary supplementation of aloe vera and clove powder increased the growth performance of Japanese

quails by enhancing white blood cells, hemoglobin, and intestinal health. Hence, it is concluded that aloe vera and clove powder could be used as a substitute of antibiotics and could be used as a growth promoter. Further investigations about the assessment of aloe vera and clove powder dietary supplementation impacts on the diversity of the gut microflora, gut morphology, organoleptic characters of the carcass, and antimicrobial activity were recommended.

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DISCLOSURES

The authors declare no conflicts of interest.

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