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Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

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Ground *Prosopis juliflora* Pods as Feed Ingredient in Poultry Diet: Effects on Nutrient Intake, Muscle Fatty Acid Composition, Sensory Quality and Hematology of Broilers

Meseret Girma[1], Mengistu Urge[2] and Getachew Animut[2]
[1]Department of Animal Sciences, Wollo University, P.O. Box 1145, Dessie, Ethiopia
[2]School of Animal and Range Sciences, Haramaya University, P.O. Box 138, Dire-Dawa, Ethiopia

Abstract: Three hundred and ninety six Hubbard Classic commercial day old chicks were used to determine the effect of Ground *Prosopis juliflora* Pods (GPJP) inclusion in broilers ration at levels of 0 (T_1), 10 (T_2), 20 (T_3) and 30% (T_4) on chemical and fatty acid composition, meat sensory quality and hematological status of birds. The birds were fed with the rations for 45 days. The experiment was arranged in a Completely Randomized Design (CRD) with four treatments, each replicated three times with 33 birds per replicate. Data of feed intake was recorded every day. The amount of nutrients consumed was determined as the difference between nutrients offered and refused on Dry Matter (DM) basis. At the end of the experiment, four randomly selected birds from each replicate (12 per treatment) were slaughtered by severing jugular vein and free flow of blood was collected into labeled sterile universal bottles. The birds were dressed by hand, carcass parts dissected, individually weighed and breast and thigh muscles were deboned and kept in refrigerator at -20°C for determination of chemical and fatty acids composition and evaluation of sensory characteristics. Intakes of DM in finisher, crude protein during starter and finisher, crude fiber in starter and finisher, ether extract during starter, ash intake during starter and finisher phases were significantly different ($p<0.05$) among the treatments. Except crude fiber intake, which increased with increasing level of GPJP, the intake of the other nutrients decreased as the inclusion level of GPJP increased. There was no adverse effect of feeding GPJP on the chemical and fatty acid composition and sensory characteristics of breast and thigh meat of broiler. Monocyte percentage of broilers was significantly higher in treatment consumed ration containing the highest GPJP as compared to the control and other treatment groups ($p<0.05$). Other Hematological parameters were not influenced by the levels of GPJP in the ration ($p>0.05$). Intestine of birds at higher level of inclusion (30% GPJP) showed minor lesions, which could be attributed to coccidiosis infection encountered during the experiment. This study indicated that up to 30% inclusion of GPJP in broiler diet did not altered chemical and fatty acid composition and sensory test of meat, but there is evidence that the highest level impaired immune response of animals to parasitic infection.

Key words: Ground *Prosopis juliflora* pods, broiler diet, fatty acid composition, sensory evaluation, meat composition, hematology

INTRODUCTION

Poultry production plays a major role in bridging the animal protein deficiency in developing countries where average daily consumption is far below recommended standards (Onyimonyi *et al*., 2008). However, the productivity of poultry in the tropics has been limited by scarcity and consequent high prices of the conventional protein and energy feeds (Atawodi *et al*., 2008). Reducing feed cost by using feed sources that are not in direct competition with human food is important to boost the profitability of poultry industry. The most appropriate strategy to meet these is developing dietary formulations which allow the use of locally available new ingredients. Consequently, feed manufacturers as well as farmers attempts to include unconventional source of raw materials for the formulation of balanced rations. Hence, there is a worldwide interest in the search for new plant species capable of supplementing traditional crops and staples (Jurgen *et al*., 1998). In this context, Ground *Prosopis juliflora* Pod (GPJP) is considered as one of the potential feed ingredient in poultry ration formulation. *Prosopis juliflora* is a leguminous tree that is native to arid and semi-arid regions of the world (Harris *et al*., 2003). It is present in North America, Africa and Asia, having multi-seeded curved pods with hardened pericarp (Habit and Saavedra, 1988). In Ethiopia, *Prosopis juliflora* is becoming a serious topic and the plant is considered as one of the invasive weeds which are rapidly invading the traditional agro-and silvo-pastoral land making the rangelands inaccessible to livestock (Sertse and Pasiecznik, 2005). Eradication of the plant by cutting as well as burning has proven to be

Corresponding Author: Meseret Girma, Department of Animal Sciences, Wollo University, P.O. Box 1145, Dessie, Ethiopia

extremely difficult and its exploitation as a resource and better management were proposed as approach to reduce its invasiveness (Pasiecznik, 2002). As a result, the use of the pod with the seed after grinding as animal feed was planned as one of the strategy to reduce its propagation.

Although *Prosopis juliflora* pods have been used in livestock as well as poultry diets and produced encouraging results in many countries and for different species of poultry (Yusuf *et al.*, 2008; AL-Beitawi *et al.*, 2010; Lemma, 2011; Meseret *et al.*, 2011a;b), few reports indicated that *Prosopis juliflora* consumption has an adverse effect on livestock product quality (Beruk, 2003; Dawit, 2010). According to the perception of pastoralists in Amibara district, Afar region of Ethiopia, goat and camel milk from *Prosopis juliflora* fed animals has a bitter taste. They also claim that it reduces milk and butter yield and meat from *Prosopis juliflora* fed goat has poor quality in terms of appearance (pale color) and flavor (Dawit, 2010). Simillarly, Beruk (2003) reported that milk obtained from goat, cow and camel fed diet based on *Prosopis juliflora* has a bitter taste. The presence of heat labile anti-nutritional factors such as trypsin inhibitor and hemagglutinin, in *Prosopis juliflora* (Del Valle *et al.*, 1983), may also induce adverse effects on animal performance and health (Apata, 2003).

However, the above mentioned quality problems on livestock products are not supported by scientific justifications and we could not find a quantitative study that shows the impact of *Prosopis juliflora* pod consumption on livestock products quality and health. It is however, true that animal performance, such as milk yield (Abedelnoor *et al.*, 2009), egg production (Silva *et al.*, 2002; Meseret *et al.*, 2011a) and growth (Choudhary *et al.*, 2005; AL-Beitawi *et al.*, 2010; Meseret *et al.*, 2011b) are hampered by high level of *Prosopis juliflora* consumption or its inclusion in livestock diet at higher level. Blood is a very good medium of assessing the health status of animals (Taiwo and Anosa, 1995). According to Karesh and Cook (1995) level of blood constituents help to evaluate disease prognosis of animals. In the present experiment, we determined fatty acid profile and conducted sensory evaluation of breast and thigh broiler meat and measured hematological status of blood to determine whether feeding ground *Prosopis juliflora* pod has any effect on product quality and broilers health.

MATERIALS AND METHODS

Experimental site: The study was conducted in Haramaya University Poultry Farm, Ethiopia which is located at 42° 3` E longitude, 9° 26`N latitude and at an altitude of 1980 meter above sea level. The mean annual rainfall of the area is 780 mm and the average minimum and maximum temperatures are 8 and 24°C, respectively (Samuel, 2008).

Experimental rations and treatments: Dietary ingredients used for this study were ground *Prosopis juliflora* Pod (GPJP), maize grain, wheat short, soybean meal, noug seed cake, methionine, salt, vitamin premix, limestone and dicalcium phosphate. Maize grain, GPJP and NSC were ground to pass 5 mm sieve at the University feed mill before mixing to formulate the ration. *Prosopis juliflora* pods were hand broken and sun-dried before grinding to produce GPJP. The ground pods were hand sieved and intact seeds and large sized pods that did not pass through the sieve were reground. Representative samples of GPJP, corn, wheat short, soybean meal and noug seed cake were taken for chemical analysis. Based on the chemical analysis result, four treatment rations containing GPJP at the level of 0% (T_1), 10% (T_2), 20% (T_3) and 30% (T_4) were formulated. The rations were formulated to be isocaloric and isonitrogenous and to contain about 3060 kcal ME/kg DM and 22% CP and 3100 kcal ME/kg DM and 18% CP to meet the nutrient requirements of broiler during the starter (1-21 days of age) and finisher (22-45 days of age) phases, respectively (Leeson and Summers, 2005).

Management of experimental birds: Three hundred ninety six unsexed day old Hubbard Classic chicks with initial weight of 45.98±0.553 g (mean±SD) were randomly divided into the four dietary treatments with three replications per treatment in a completely randomized design experiment, thus having 33 chicks per replicate/pen. The birds were vaccinated against Marek's disease at hatching by injection. Vaccination for Newcastle disease was given through an eye drop at the age of three days and a booster dose was given at 24 days of age in drinking water. Birds were also vaccinated for Infectious Bursal Disease (Gumboro) through drinking water at seven days of age and a booster at 18 days of age.

Before placing the chicks in the experimental house, the pens, watering and feeding troughs were thoroughly cleaned, disinfected and sprayed against external parasites. The chicks were brooded using 250 watt infrared electric bulbs as sources of heat and light with gradual height adjustment in a deep litter house covered with sawdust litter material. Feed was offered *ad libitum* and clean tap water was available all the time throughout the experiment. The amount of nutrients consumed was determined as the difference between nutrients in the feed offered and refused on DM basis.

Fatty acid determination: At the end of the experiment (45 days), four randomly selected birds from each replicate (12 per treatment) were starved for 16 hrs, weighed, sacrificed humanly by severing neck with sharp knife, slaughtered, dressed and carcasses were tagged with coded bands. Each carcass was cut into breast and leg quarters, individually packaged and transported to the Animal Physiology and Food Science Laboratory of Haramaya University for evaluation. Twelve broiler carcasses (breast and thigh muscle) per treatment group were evaluated for fatty acid profile and sensory characteristics. Fat was extracted from the meat samples according to the method described by AOAC (1995). Fatty acid profile was determined through methyl ester preparation by transmethylation following the procedure of Adriana *et al.* (2009) using 2 mol/L KOH in methanol and hexane. Fatty Acid Methyl Esters (FAME) were analyzed using gas chromatograph at organic chemistry laboratory of Addis Ababa University, Ethiopia.

Sensory evaluation of meat: The sensory parameters determined were juiciness, tenderness, aroma and general impression. Skinless breast and thigh muscle samples were frozen until used. On the day of the cooking, the pieces were thawed at room temperature, minced and cut into 2.5 cm cubes. Breast meat was cooked for 15 min on a pan by vegetable oil, but without salt. Thigh cooking required 2 min more than the breast. After cooking, the pieces were cooled to room temperature. The samples were reweighed to determine losses or gain and cooked to evaluate sensory characteristics. The breast and thigh meats were evaluated following the sensory profile procedure (ISO, 2003). The panel consist 20 trained graduating classes of undergraduate and postgraduate students of Food Science Department of Haramaya University. Panelists were instructed to chew and taste the meat, drink water and rinse their mouth with bottled drinking water of room temperature between each sample and pause for 20 sec before tasting the next sample. The panelists consumed all samples served (three cubes per treatment).

Chemical composition of meat: Chemical composition of the meat samples was analyzed following the procedure of AOAC (1995). Samples of raw breast and thigh muscles were minced, dried and ground and analyzed for the content of dry matter, crude protein, ether extract and ash. Dry matter was determined by drying 6 g of ground meat samples in a draft oven at 105°C for 24 hrs. Nitrogen (N) was determined according to Kjeldahl procedure and crude protein content of the sample was calculated as N*6.25 (AOAC, 1995). Total lipid (ether extract) content of the muscles were determined following the standard procedure (AOAC, 1995). Total mineral content was determined by burning 6 g of the samples in a muffle furnace at 550°C. All analysis was done in duplicate.

Determination of hematological parameters: Blood samples were collected from all birds slaughtered into two labeled sterile universal bottles. One set of the bottles contained Ethyldiamine Tetra Acetic Acid (EDTA) powder as anti-coagulant, while the other set did not contain any anticoagulant. Hemoglobin (HB) concentration was determined from samples in bottles containing anticoagulant taken before spinning in centrifuge by the method of Actin hematin (Davice and Lewis, 1991). Blood samples in bottles containing anticoagulant were spun in a centrifuge at 3,000 rpm for 10 min and plasma was separated and stored frozen at -10°C. These samples were used for the determination of Percentage Packed Cell Volume (PCV), total protein and differential white blood cell count (lymphocyte, heterophils, eosinophils, monocytes and basophils). Total protein was determined by refractometer (Leica INC, Buffalo NY, USA). The PCV was determined by spinning blood filled capillary tubes in a centrifuge at 1200 revolution per minute (rpm) for 5 min and reading on hematocrit reader. Differential white blood cell counts were determined by blood smear with Wright's stain. The hematological parameters were determined as described by Davice and Lewis (1991). At the time of slaughter, gastrointestinal tract and organs were examined for any pathological symptoms and gross lesions were recorded when observed.

Statistical analysis: Data were analyzed using the general linear model procedure of SAS software (SAS, 2002) with the model containing treatments. Differences between treatment means were separated using Tukey Test.

RESULTS

The details of the composition of the starter and finisher rations used in the present experiment are published earlier (Meseret *et al.*, 2011b). The four experimental rations as planned were almost isocaloric and isonitrogenous and the nutrient content of the diets were within the recommended values for starter and finisher broiler diets (Leeson and Summers, 2005). The result revealed that intakes of dry matter in finisher phase, crude protein during starter and finisher phases, crude fiber in starter and finisher phases, ether extract during starter phase, ash intake during starter and finisher phases were significantly different ($p<0.05$) among the treatments (Table 1). Except crude fiber intake that increased as the inclusion level of GPJP increased, intake of other nutrients decreased as the inclusion of GPJP increased.

There were no significant difference ($p>0.05$) among treatments in the fatty acid composition of breast (Table 2) and thigh muscles (Table 3). Juiciness, tenderness, flavor and overall acceptance (Table 4) and the chemical composition of the breast and thigh muscles (Table 5) were not also affected ($p>0.05$) by the inclusion of GPJP. Contents of palmitic acid, 11, 14 eicosadienoic acids and Saturated Fatty Acids (SFA) such as arachidic acid were higher in breast muscle, while contents of all other

Table 1: Mean daily nutrient intake of broilers fed diets containing graded levels of ground *Prosopis juliflora* pods

	Treatments				
Parameters	T_1	T_2	T_3	T_4	SEM
DMI (g/chick/d)					
Starter (1-21 days)	42.73	42.62	42.42	42.02	0.440
Finisher (22-45 days)	129.40[a]	127.60[b]	126.50[c]	124.70[d]	0.000
CPI (g/chick/d)					
Starter (1-21 days)	10.36[a]	10.31[a]	10.12[ab]	9.90[b]	0.125
Finisher (22-45 days)	28.36[a]	27.97[ab]	26.83[bc]	26.24[c]	0.408
CFI (g/chick/d)					
Starter (1-21 days)	2.33[b]	2.45[b]	3.15[a]	3.29[a]	0.050
Finisher (22-45 days)	7.04[d]	8.07[c]	9.17[b]	9.77[a]	0.046
EEI (g/chick/d)					
Starter (1-21 days)	3.251[a]	3.222[b]	3.221[c]	3.206[d]	0.000
Finisher (22-45 days)	8.74	8.75	8.75	8.74	0.050
AshI (g/chick/d)					
Starter (1-21 days)	4.02[a]	4.01[a]	3.85[b]	3.82[b]	0.051
Finisher (22-45 days)	15.38[a]	15.37[a]	14.59[b]	13.53[c]	0.050
CaI (g/chick/d)					
Starter (1-21 days)	0.50	0.49	0.47	0.46	0.049
Finisher (22-45 days)	1.38	1.36	1.32	1.29	0.049
PI (g/chick/d)					
Starter (1-21 days)	0.21	0.20	0.19	0.19	0.048
Finisher (22-45 days)	0.71	0.68	0.59	0.59	0.090

[a-d]Means within a row with different superscripts differ ($p<0.05$); SEM = Standard Error of the Mean; GPJP = Ground *Prosopis juliflora* Pod; T_1 = Diet containing 0% GPJP; T_2 = Diet containing 10% GPJP; T_3 = Diet containing 20% GPJP; T_4 = Diet containing 30% GPJP; DMI = Dry matter Intake; CPI = Crude Protein Intake; CFI = Crude Fiber Intake; EEI = Ether Extract Intake; AshI = Ash Intake; CaI = Calcium Intake; PI = Phosphorus Intake

Table 2: Effect of graded levels of dietary ground *Prosopis juliflora* pods on fatty acid composition (% of total fatty acids) in breast muscle of broilers

	Treatments				
Parameters	T_1	T_2	T_3	T_4	SEM
Myristic acid (C14:0)	0.553	0.552	0.551	0.552	0.0021
Palmitic acid (C16:0)	20.111	20.101	20.112	20.111	0.0063
Stearic acid (C18:0)	10.811	10.812	10.811	10.813	0.0066
Oleic acid (C18:1)	24.521	24.522	24.522	24.523	0.0095
Linoleic acid (C18:2)	19.333	19.934	19.932	19.931	0.0085
Alpha-linolenic acid (C18:3)	2.111	2.112	2.112	2.113	0.0087
Arachidic acid (C20:0)	5.421	5.421	5.422	5.422	0.0092
Gondoic acid (C20:1)	0.441	0.442	0.442	0.443	0.0103
11,14 Eicosadienoic acid (C20:2)	1.442	1.442	1.443	1.443	0.0100
Dihomo-gamma-Linolenic acid (C20:3)	0.344	0.343	0.341	0.342	0.0090
Arachidonic acid (20:4)	1.351	1.351	1.352	1.352	0.0090
Behenic acid (C22:0)	0.242	0.242	0.241	0.243	0.0098
Adrenic acid (22:4)	0.423	0.422	0.422	0.423	0.0093
SFA	37.138	37.128	37.137	37.141	0.0050
MUFA	24.962	24.964	24.964	24.966	0.0049
PUFA	25.257	25.259	25.259	25.259	0.0126
PUFA/SFA	0.680	0.680	0.680	0.680	0.0100

SEM = Standard Error of the Mean; GPJP = Ground *Prosopis juliflora* Pod; T_1 = Diet containing 0% GPJP; T_2 = Diet containing 10% GPJP; T_3 = Diet containing 20% GPJP; T_4 = Diet containing 30% GPJP; SFA = Saturated Fatty Acid (C14:0 + C16:0 + C18:0 + C20:0 + C22:0); MUFA = Monounsaturated Fatty Acid (C18:1 + C20:1); PUFA = Polyunsaturated Fatty Acid (C18:2 + C18:3 + C20:2 + C20:3 + C20:4 + C22:4)

fatty acids are higher in thigh muscle. As shown in Table 6, graded levels of GPJP inclusion in broilers ration did not significantly ($p>0.05$) affect the hematological indices and total protein of broiler chicken as compared to the control, except monocytes. The value for monocytes was higher ($p<0.05$) for the ration containing the highest level (30%) of GPJP. No symptom of gastro intestinal tract infection was observed up to 20% of GPJP inclusion in the ration. However, intestine of birds fed with diet containing higher level of GPJP inclusion (30%) has lesions and intestinal hemorrhages were visible without opening the gut. The content of the intestinal lumen also consisted visible blood (Patra *et al*., 2009). The caeca were not severely affected.

Table 3: Effect of graded levels of dietary ground *Prosopis juliflora* pods on fatty acid composition (% of total fatty acids) in thigh muscle of broilers

	Treatments				
Parameters	T_1	T_2	T_3	T_4	SEM
Myristic acid (C14:0)	0.611	0.612	0.612	0.611	0.0017
Palmitic acid (C16:0)	19.411	19.412	19.411	19.413	0.0020
Stearic acid (C18:0)	11.111	11.113	11.112	11.111	0.0046
Oleic acid (C18:1)	28.254	28.253	28.253	28.255	0.0027
Linoleic acid (C18:2)	21.222	21.224	21.224	21.223	0.0052
Alpha-linolenic acid (C18:3)	5.241	5.241	5.242	5.242	0.0131
Arachidic acid (C20:0)	3.912	3.913	3.913	3.912	0.0095
Gondoic acid (C20:1)	0.624	0.623	0.623	0.624	0.0116
11,14 Eicosadienoic acid (C20:2)	0.771	0.772	0.772	0.771	0.0097
Dihomo-gamma-Linolenic acid (C20:3)	0.461	0.463	0.462	0.462	0.0042
Arachidonic acid (C20:4)	1.564	1.565	1.565	1.564	0.0084
Behenic acid (C22:0)	0.343	0.344	0.343	0.342	0.0088
Adrenic acid (22:4)	0.471	0.471	0.472	0.472	0.0105
SFA	35.388	35.394	35.391	35.389	0.0046
MUFA	28.878	28.876	28.876	28.879	0.0055
PUFA	29.268	29.272	29.273	29.270	0.0118
PUFA/SFA	0.827	0.827	0.827	0.827	0.0043

SEM = Standard Error of the Mean; GPJP = Ground *Prosopis juliflora* Pod; T_1 = Diet containing 0% GPJP; T_2 = Diet containing 10% GPJP; T_3 = Diet containing 20% GPJP; T_4 = Diet containing 30% GPJP; SFA = Saturated Fatty Acid (C14:0 + C16:0 + C18:0 + C20:0 + C22:0); MUFA = Monounsaturated Fatty Acid (C18:1 + C20:1); PUFA = Polyunsaturated Fatty Acid (C18:2 + C18:3 + C20:2 + C20:3 + C20:4 + C22:4)

Table 4: Meat sensory characteristics of broilers fed graded levels of ground *Prosopis juliflora* pods

	Treatments				
Parameters*	T_1	T_2	T_3	T_4	SEM
Juiciness					
Breast	3.92	3.76	3.94	3.82	0.065
Thigh	4.11	4.11	4.23	4.11	0.067
Tenderness					
Breast	3.59	3.59	3.59	3.59	0.009
Thigh	4.17	4.29	4.11	4.11	0.067
Flavor					
Breast	3.53	3.53	3.53	3.53	0.063
Thigh	4.11	4.11	4.11	4.11	0.017
Overall acceptance					
Breast	4.17	4.23	4.15	4.15	0.048
Thigh	4.17	4.00	4.00	4.00	0.067

SEM = Standard Error of the Mean; GPJP = Ground *Prosopis juliflora* Pod; T_1 = Diet containing 0% GPJP; T_2 = Diet containing 10% GPJP; T_3 = Diet containing 20% GPJP; T_4 = Diet containing 30% GPJP; *Sensory scale = Five-point sensory scale for juiciness, flavor, tenderness and overall acceptance; Juiciness (5 = very juicy, 4 = juicy, 3 = moderately juicy, 2 = dry and 1 = very dry); Tenderness (5 = very tender, 4 = tender, 3 = moderately tender, 2 = tough and 1 = very tough); Flavor (5 = excellent, 4 = good, 3 = accepted, 2 = poor and 1 = extremely poor); Overall acceptance (5 = excellent, 4 = good, 3 = accepted, 2 = poor and 1 = extremely poor)

Table 5: Meat chemical composition of broilers fed graded levels of ground *Prosopis juliflora* pods

	Treatments				
Parameters (%)	T_1	T_2	T_3	T_4	SEM
Moisture					
Breast	75.41	75.83	75.92	75.95	0.981
Thigh	73.51	73.96	73.79	73.47	1.502
Crude protein					
Breast	23.02	23.93	23.14	23.59	0.967
Thigh	21.68	21.67	21.68	21.67	0.005
Ether extract					
Breast	2.56	2.52	2.64	2.52	0.108
Thigh	7.63	7.63	7.63	7.63	0.020
Ash					
Breast	2.91	2.91	2.91	2.91	0.010
Thigh	1.19	1.19	1.13	1.18	0.021

SEM = Standard Error of the Mean; GPJP = Ground *Prosopis juliflora* Pod; T_1 = Diet containing 0% GPJP; T_2 = Diet containing 10% GPJP; T_3 = Diet containing 20% GPJP; T_4 = Diet containing 30% GPJP

DISCUSSION

The reason for increased crude fiber intake of chicks with increasing GPJP inclusion is due to the high fiber content of GPJP as compared to other feed ingredients (Meseret *et al.*, 2011a,b). High dietary fiber is often associated with slower rate of passage and may inhibit optimal digestion and through the gut filling effect may lead to a consequent reduction in feed consumption (Thorne *et al.*, 1992). In agreement with this general reality, nutrient intake of broilers in the present study decreased at higher level of GPJP inclusion to the broiler ration. Essential amino acids such as lysine, methionine and cysteine are known to enhance feed intake (Melesse *et al.*, 2011). However, *Prosopis juliflora* meal is deficient in these essential amino acids (Bhatt *et al.*, 2011), which could have been contributed to the low feed intake of broilers at higher level of GPJP inclusion. Moreover, antinutritonal factors in *Prosopis juliflora* such as trypsin inhibitor and hemagglutinin (Del Valle *et al.*, 1983) might have also depressed feed intake (Shahidi, 1997).

Table 6: Effect of dietary ground *Prosopis juliflora* pods on some hematological indices and total protein of broiler chickens

	Treatments				
Parameters	T_1	T_2	T_3	T_4	SEM
Packed Cell Volume (PCV, %)	30.33	30.00	29.33	28.00	5.238
Hemoglobin (Hb, g/dL)	9.50	9.33	9.33	9.00	0.833
Lymphocyte (%)	40.00	41.33	43.66	44.33	3.210
Heterophils (%)	45.66	46.00	46.33	46.66	4.297
Eosinophils (%)	3.66	4.00	4.33	4.66	0.745
Monocytes (%)	1.66^b	1.66^b	1.66^b	2.66^a	0.500
Basophils (%)	1.66	1.66	1.66	1.33	0.645
Total protein (g/dL)	3.33	3.30	3.30	3.33	0.044

SEM = Standard Error of the Mean; GPJP = Ground *Prosopis juliflora* Pod; T_1 = Diet containing 0% GPJP; T_2 = Diet containing 10% GPJP; T_3 = Diet containing 20% GPJP; T_4 = Diet containing 30% GPJP; dL = deci Liter

The fatty acids composition of breast and thigh muscles recorded in the present experiment are within the range reported for broiler meat (Cherian *et al*., 2002; Salma *et al*., 2007). In the present study, graded levels of GPJP in broiler diets did not significantly affect the ratio between Polyunsaturated Fatty Acid (PUFA) and Saturated Fatty Acids (SFA) in the thigh and breast muscles. However, the ratio is a little lower than that recommended (1:1) for safe consumption by human beings (AHA, 1991). Several nutritional studies strongly support the presence of relationship between SFA and the risk of cardiovascular diseases. In view of dietary health, food that contains more Unsaturated Fatty Acids (UFA) and relatively lower cholesterol contents can help in reducing the occurrence of cardiovascular diseases (Salma *et al*., 2007). Hence, higher MUFA and PUFA content of broiler muscles as in the present and earlier studies (Garcia *et al*., 1999) signifies better value of the muscles for human consumption. The result of the present study confirmed the existing evidence which reported that tissue concentration of fatty acids is less altered by dietary changes (Cortinas *et al*., 2004). Furthermore, Jamroz (1997) noted that body lipid ratio is more influenced by genetic factors and depended on poultry species, but not on the type of feeding. Osek *et al*. (2004) reported that the type of fat added to feed influenced the proportion of lipid fraction of meat and abdominal fat and as such GPJP with lower ether extract content (Meseret *et al*., 2011a,b) may not be expected to alter fatty acid composition of meat.

Feeding fat with a high level of alpha-linolenic acid in the diet of animals is advantageous to produce finely fibrous, juicy and tastier meat (Zelenka *et al*., 2008). However, GPJP contains low level of alpha-linolenic, which is only about 1.68% (Kathirvel and Kumudha, 2011) as compared to high alpha-linolenic content of diets such as soyabean oil (6%) (Yettella *et al*., 2011). Hence, differences were not observed in eating quality parameters of muscles between the treatments. Generally, the result for sensory evaluation demonstrated that differences in sensory characteristics are mainly due to muscle type and not the addition of GPJP at all levels. Thigh meat, which is inherently higher in fat content than breast meat (Stadelman *et al*., 1988), was higher in juiciness and flavor when compared to breast meat in all the treatments. Many of the flavor imparting components of poultry meat are fat soluble and would be more abundant in the thigh meat than breast meat (Lindsay, 1985).

The chemical compositions of breast and thigh muscles recorded in the present experiment are within the range reported for broiler meat (Abdullah *et al*., 2010). In the present study, graded levels of GPJP in broiler diets did not significantly affected chemical composition of thigh and breast muscle. Both thigh and breast muscles have high protein content as compared to the amount of fat. Meat with low fat content has a lower energetic value, but also has a higher biological value, since protein content is higher in low fat meat (Marcu and Opris, 2009), indicating that the biological value of the meat produced by broilers fed *Posopis juliflora* pod in the diet up to 30% is not much affected.

The values obtained for all hematological parameters are almost uniform across the treatments and was within the normal range (Douglas *et al*., 2010). Hematological constituents reflect the physiological responsiveness of the animals to its internal and external environment including the type of feed the animal consumed and feeding practices (Esonu *et al*., 2001). Although PCV and hemoglobin (Table 6) slightly decreased and most leukocytes marginally increased as the level of GPJP in the ration increased, there was no significant evidence supporting the perception that GPJP inclusion in livestock diet impedes health status of animals. Monocyte numbers increases in chronic infections and are especially valuable in the defense against long-term inflammation. In the present study, broilers consumed the highest level of GPJP has significantly higher monocyte count indicating the possible presence of infection. Coccidiosis problem was observed in the later phase of the experiment. Higher monocyte count observed could therefore, be attributed to infection as a result of coccidiosis inflammation and the greatest level of GPJP might have predisposed the birds for parasitic infection. In general, inclusion of GPJP up to 30% into the diet of broilers reduced nutrients intake and mildly predisposed the animal to parasitic infection, but did not have adverse effect on the fatty acid composition in breast and thigh muscle, sensory evaluation and chemical composition of meat of broiler chickens. Considering the easy availability and its nutritional quality, GPJP can be incorporated safely in commercial broilers diet up to 20%.

Summery and conclusion: Fatty acid composition, sensory characteristics and chemical composition of breast and thigh muscles of the broilers were not negatively affected by inclusion of GPJP up to 30% in the ration. There was significant reduction in nutrient intakes, except fiber, with increasing levels of inclusion of GPJP. Mild reduction in hematological indices with increasing level of GPJP and significantly higher monocyte at 30% GPJP inclusion in the ration may indicate the negative effect of high level of GPJP inclusion in broilers ration on immune response of birds. Based on the results obtained in this study, it can be concluded that inclusion of GPJP in the rations of broilers up to a maximum of 20% appeared to be safe.

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