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Haematological And Biochemical Parameters Of Broiler Chickens Fed Processed Or Raw Tropical Sickle Pod (*Senna obtusifolia*) Seed Meal-Based Diets

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Abstract: A feeding trial was conducted for eight (8) weeks to evaluate the haematological and biochemical indices of broiler chickens fed processed or raw tropical sickle pod (*Senna obtusifolia*) seed meal-based diets. Six (6) experimental diets were compounded to contain 0% and 20% each of the raw, boiled in water, soaked in water, sprouted and boiled and fermented *Senna obtusifolia* seed meal designated as T1, T2, T3, T4, T5 and T6, respectively. Two hundred and sixteen (216) broiler chicks were randomly allotted to the six dietary treatments in a randomized complete block design (RCBD) with pen location serving as the blocking factor. Each replicate contained 12 chicks each. At the end of the experiment, blood samples were collected using standard procedure. Each representative blood sample was analyzed in triplicates for packed cell volume (PCV), haemoglobin (Hb), red blood cell (RBC) and white blood cell count (WBC). The erythrocytic indices (mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were computed using standard formula. The blood samples were also analyzed for serum total protein, albumin, globulin, uric acid, cholesterol, creatinine, electrolytes, enzymes and bilirubin. The haematological parameters were significantly ($P<0.05$) affected by the dietary treatments except for the Hb, RBC, MCH and MCHC. The lowest PCV (25.54%) was recorded in broiler chickens fed raw *Senna obtusifolia* seed meal-based diets. The Highest WBC value ($2.71x10^3$/ml) was also observed in broiler chickens fed the raw *Senna obtusifolia* seed meal-based diet. Better haemological values were observed in broiler chickens fed the control diet (T1, 0% SOSM) and processed *Senna obtusifolia* seed meal-based diet with those fed the fermented seed meal-based diet recording better haematological status. The biochemical parameters were significantly ($P<0.05$) affected by the dietary treatments except for the globulin. The broiler chickens fed the raw *Senna obtusifolia* seed meal-based diet recorded the lowest values for total protein (1.97 g/dl), albumin (1.52 g/dl) and cholesterol (22.1 mg/dl). The concentration of serum electrolytes similarly followed similar pattern as that of the total protein, albumin and cholesterol. Low values for calcium (2.17 mmol/L) and phosporus (2.07 mmol/L) were recorded in broiler chickens fed the raw *Senna obtusifolia* seed meal-based diet. However, better serum electrolytes values were recorded in the chickens fed the processed *Senna obtusifolia* seed meal-based diets with those fed the fermented *Senna obtusifolia* seed meal-based diet indicating better electrolytes status. Serum enzymes and bilirubin levels were observed to be significantly ($P<0.005$) elevated in broiler chickens fed the raw *Senna obtusifolia* seed meal-based diet. Aspartate aminotransferase and alanine aminotransferase were 9.27 and 8.53µ/L in the broiler chickens fed raw *Senna obtusifolia* seed meal (RSOSM) based-diet. Similarly, high level of bilirubin (16.38 mmol/L) was observed in broiler chickens fed RSOSM-based diet. It was concluded that better haematological and biochemical status were observed in the broiler chickens fed 20% fermented *Senna obtusifolia* seed-meal based diet and is therefore recommended for inclusion in the diets of broiler chickens.
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Introduction

Poultry farmers in Nigeria are constantly faced with the problem of high cost of feeds and feed ingredients thereby contributing to the high cost of poultry production. This was further supported by Omotoso *et al*. (2017) who reported that nutrition is the most important aspect in livestock management as it covers about 70% of the total cost of production under intensive system of poultry management. This major problem therefore, necessitates the need to exploit alternative feed resources that are under-utilized in Nigeria. Augustine (2017) further suggested the use of lesser-known legumes as way to address the escalating

feed crises in the Nigerian livestock industry. One of such lesser-known legumes that has long been under-exploited as livestock feed resource in Nigeria is *Senna obtusifolia* seed which is a short-lived annual or biennial shrub growing up to 2.5 m tall, but usually less than 2 m in height. (Lusweti, 2011).

The chemical composition of the seeds as reported by Ingweye *et al*. (2010) and Augustine *et al*. (2017) revealed that the seeds have good protein content (23.40 – 25.90%) and fair distribution of amino acids. Unfortunately, the authors further revealed that the seeds contain anti-nutritional factors which might limit nutrient utilization and adversely affect the overall animal performance and its blood constituents. Therefore, it is important to subject the seed to processing before feeding to poultry birds.

One of the fastest means of assessing the health status of animals fed a particular diet is the use of blood analysis (Maxwell, 1990). Furthermore, blood is also an important means of assessing the effects of a diet on physiological, pathological and nutritional status in animals (Olorede *et al*., 2007; Ewuola *et al*., 2004). At the moment, base-line information on the effects of raw or processed *Senna obtusifolia* seed meal based-diets on blood constituents of broiler chickens seems to be very scanty. Therefore, more studies are required to bridge this information gap. In view of the above, this study was conducted to evaluate the effects of feeding raw or processed *Senna obtusifolia* seed meal on blood parameters of broiler chickens in Mubi area of Adamawa State, Nigeria.

Materials and Methods

Location of the study area

The research was conducted at the Poultry Unit of the Department of Animal Production Livestock Teaching and Research Farm, Adamawa State University, Mubi, Nigeria. The area is located between latitudes 9º30ˡ and 11º North of the equator and longitudes 13º and 13º 45ˡ East of the Greenwich meridian (Adebayo, 2004). The dry season of the area normally start by early October and last up to April while the wet season begins from May and reach its peak in July and August and declines in September.

The average temperature and rainfall of the area are 25.4ºC and 935 mm (Climate-Data. Org, 2018).

Processing of *Senna obtusifolia* seed

The seeds of *Senna obtusifolia* were harvested in bushes around Mubi area of Adamawa State, Nigeria.

The seeds were divided into five batches. The first batch was left unprocessed (raw) while the second, third, fourth and fifth batches were boiled in water for one hour, soaked in water for 24 hours, sprouted and boiled and fermented, respectively. The processed seeds were properly sun-dried, milled and used for the feeding trial.

Chemical analysis

The raw, processed seed meals and the experimental diets were analysed using standard laboratory procedure of AOAC (2004).

Experimental stock and their management

Two hundred and sixteen (216) day-old broiler chicks were managed on deep litter pens. The broiler chicks were fed broiler starter diet for five (5) weeks and the finisher diets fed from 6 to 8 weeks. The chicks were vaccinated against Gumboro disease for first and second doses at 2 and 4 weeks of ages and Newcastle disease at 3 and 5 weeks of ages. The experiment lasted for eight (8) weeks.

Experimental diets (treatments)

Six experimental diets were compounded to contain 0 and 20% each of the raw, boiled, soaked, sprouted and boiled and fermented *Senna obtusifolia* seed meals, designated as T1, T2, T3, T4, and T6, respectively (Tables 1 and 2).

Experimental design

The chicks were individually weighed and randomly allotted to the six (6) dietary treatments in a randomized completely block design (RCBD) with pen location serving as the blocking factor. Each treatment group consisted of thirty (36) birds replicated three times with twelve (12) birds per replicate.

Collection of blood sample

At the end of the experiment, three (3) birds were randomly selected from each replicate pen and used for blood collection. About 7 ml of the blood samples for haematological analysis were collected using standard procedure in an ethylene diamine tetra acetic acid (EDTA) treated tubes. The blood samples for biochemical analyses, on the other hand, were collected into an EDTA–free test tubes and allowed to clot for serum separation. Serum was separated from the plasma by centrifugation of the blood at 4000 rpm for 15 minutes and thereafter quickly taken to the Laboratory for analysis. The haematology and blood chemistry analyses were carried out according to the procedure of Ochei and Kolhatkar (2007).

Table 1: Ingredient Composition and Calculated Analysis of the Experimental Broiler Starter Diets

	Level of inclusion of the raw or processed SOSM (%)					
Ingredients	T1 0% SOSM	T2 20% RSOSM)	T2 20% BSOSM)	T4 20% SKSOSM)	T5 20%SPSOS	T6 20%FSOSM
Maize	50.00	50.00	50.00	50.00	50.00	50.00
Maize offal	4.00	4.00	4.00	4.00	4.00	4.00
Roasted soya bean	23.05	9.05	9.05	9.05	9.05	9.05
SOSM	0.00	20.00	20.00	20.00	20.00	20.00
Fishmeal	6.00	5.00	5.00	5.00	5.00	5.00
GNC	13.00	8.00	8.00	8.00	8.00	8.00
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20	0.20
Premix*	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis						
energy (kcal/kg)	2912.44	2906.80	2905.08	2903.40	2907.24	29011.00
Protein (%)	23.15	22.23	22.15	22.78	22.48	22.65
Fibre (%)	2.88	3.13	3.12	3.08	3.11	2.98
Methionine (%)	0.77	0.76	0.77	0.75	0.73	0.70
Lysine (%)	1.39	1.38	1.36	1.32	1.29	0.75
Calcium (%)	1.31	1.30	1.32	1.30	1.29	1.33
Phosphorus (%)	0.73	0.73	0.74	0.73	0.71	0.75

Metabolizable energy (ME) calculated according to the formula of Pauzenga, (1985) ME= 37 × % CP + 81× % EE + 35.5 × % NFE, GNC = Groundnut cake, SOSM = *Senna obtusifolia* seed meal, RSOSM = Raw *Senna obtusifolia* seed meal, BSOSM = Boiled *Senna obtusifolia* seed meal, SkSOSM = Soaked *Senna obtusifolia* seed meal, SPSOSM = Sprouted *Senna obtusifolia* seed meal and FSOSM = Fermented *Senna obtusifolia* Seed meal

Table 2: Ingredient Composition and Calculated Analysis of the Experimental Broiler Finisher Diets

	Level of inclusion of the raw and processed SOSM					
Ingredients	**T1 0%SOSM)**	**T2 20% RSOSM**	**T3 20% BSOSM**	**T4 20% SKSOSM**	**T5 20% SPSOSM**	**T6 20% FSOSM**
Maize	54.00	54.00	54.00	54.00	54.00	54.00
Maize offal	6.00	7.00	7.00	7.00	7.00	7.00
Roasted Soya bean	20.15	5.15	5.15	5.15	5.15	5.15
SOSM	0.00	20.00	20.00	20.00	20.00	20.00
Fishmeal	5.00	6.00	6.00	6.00	6.00	6.00
Groundnut cake	11.00	4.00	4.00	4.00	4.00	4.00
Salt	0.20	0.20	0.20	0.20	0.20	0.20
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20	0.20
Premix*	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculate Analysis						

ME energy (kcal/kg)	3119.39	2930.39	2910.50	2903.02	2931.98	2922.11
Protein (%)	19.99	19.45	19.55	19.95	19.65	20.01
Fibre (%)	3.40	3.61	3.91	3.90	4.01	3.20
Methionine (%)	0.61	0.75	0.70	0.73	0.79	0.83
Lysine (%)	1.36	2.70	2.74	2.69	2.61	2.92
Calcium (%)	1.25	0.64	0.63	0.58	0.65	0.59
Phosphorus (%)	0.69	0.65	0.64	0.66	0.63	0.68

Metabolizable energy (ME) calculated according to the formula of Pauzenga, (1985) ME= 37 × %CP + 81 × % EE + 35.5 × % NFE, SOSM = *Senna obtusifolia* seed meal, RSOSM = Raw *Senna obtusifolia* seed meal, BSOSM = Boiled S*enna obtusifolia* seed meal, SkSOSM = Soaked *Senna obtusifolia* seed meal, SPSOSM = Sprouted *Senna obtusifolia* seed meal and FSOSM = Fermented *Senna obtusifolia* seed meal.

Erythrocytic indices

Erythrocytic indices (mean corpuscular haemoglobin concentration (MCHC), mean corpuscular haemoglobin (MCH) and mean corpuscular volume (MCV)) were calculated using the formula of Jain (1986) as follows:

$$MCHC\ (\%) = \frac{Hb(g/dl \times 100}{PCV\ (\%)}$$

$$MCH\ (f\,l) = \frac{Hb(g/dl) \times 10}{RBC\ (\times 10^6 UL)}$$

$$MCV\ (pg) = \frac{PCV\ (\%) \times 10}{RBC\ (million)}$$

Note:
F l – femtolitre
Pg – pictogram

Results and Discussion

The result of the proximate composition of the experimental broiler starter and finisher diets are presented in Tables 3 and 4, respectively. The crude protein content of the starter and finisher diets are close to the values 23 and 20% respectively for starter and finisher diets recommended by Aduku (1995) as the optimum protein requirement for broiler chickens in the tropics.

The levels of condensed tannins and total phenols of the experimental diets revealed that these anti-nutritional factors were relatively high in the raw *Senna obtusifolia* seed meal-based diet compared to the positive control diet (0% SOSM) and the boiled, soaked, sprouted and fermented *Senna obtusifolia* seed meal-based diets. This is an indication that the different processing methods used were effective in reducing the levels of the anti-nutritional factors. This findings concurred with the report of Udedibie (1990) who found processing methods such as soaking, boiling and fermentation to be effective in reducing anti-nutritional factors in legume grains. The fibre contents of the experimental diets (T2 to T6) were however, higher than the recommended fibre content of 3.5% to 5% reported by Payne (1990) for broiler chickens. The higher fibre levels of the diets may be due to the relatively high fibre content (14.5%) and hard seed coat of the *Senna obtusifolia* seeds. The fibre content of the raw *Senna obtusifolia* seed meal-based diets was however, higher than the processed *Senna obtusifolia* seed meal based-diets. This is an indication that the processing methods have reduced the fibre content of the seeds. This is in line with the observation of Nsa *et al*. (2011) who observed a decreased in the fibre content of soaked and boiled castor oil seeds.

Table 3: Proximate Composition and Levels of Anti-nutritional Factors of Experimental Broiler Starter Diets

Parameters	Level of inclusion of the raw or processed SOSM					
	T1 (0% SOSM)	T2 (20% RSOSM)	T3 (20% BSOSM)	T4 (20% SkSOSM)	T5 (20% SPSOSM)	T6 (20% FSOSM)
Dry matter (%)	92.41	92.50	92.12	93.13	92.84	91.52
Crude protein (%)	22.38	19.82	21.95	19.80	20.70	21.91
Crude fibre (%)	4.80	5.79	6.24	7.17	7.06	5.56
Ether extract (%)	7.52	6.89	6.62	6.38	7.42	6.36
Ash (%)	7.50	5.90	6.64	6.78	6.71	6.70
NFE (%)	46.17	46.86	45.75	46.27	45.08	46.37
Tannins (%)	0.01	0.68	0.24	0.30	0.33	0.21
TP (%)	0.03	0.97	0.30	0.36	0.31	0.29

RSOSM = Raw *Senna obtusifolia* seed meal; BSOSM = Boiled *Senna obtusifoli* seed meal; SkSOSM = Soaked *Senna obtusifolia* seed meal; SPSOSM = Sprouted *Senna obtusifolia* seed meal; FSOSM = Fermented *Senna obtusifolia* seed meal.

Table 4: Proximate Composition and Levels of Anti-nutritional Factors of Experimental Broiler Finisher Diets

Parameters	Level of inclusion of the raw or processed SOSM					
	T1 (0%) SOSM	T2 (20%) RSOSM	T3 (20%) BSOSM	T4 (20%) SKSOSM	T5 (20%) SPSOSM	T6 (20%) FSOSM
Dry matter (%)	93.05	93.40	92.79	93.40	93.26	93.54
Crude protein (%)	19.25	18.75	18.64	19.72	18.95	19.98
Crude fibre (%)	5.90	6.95	8.84	7.11	6.92	6.09
Ether extract (%)	7.12	6.75	7.55	6.98	6.57	6.71
Ash (%)	7.08	6.97	6.46	6.16	7.08	6.83
NFE (%)	49.13	48.11	47.97	45.54	47.12	46.81
Calcium (%)	1.87	0.98	1.05	1.17	1.52	1.30
Phosphorus (%)	0.46	0.43	0.48	0.42	0.39	0.47
Tannins (%)	0.00	0.62	0.28	0.32	0.35	0.23
Total phenols (%)	0.00	0.84	0.31	0.34	0.41	0.31

Raw *Senna obtusifolia* seed meal; BSOSM = Boiled *Senna obtusifoli* seed meal; SKSOSM = Soaked *Senna obtusifolia* seed meal; SPSOSM = Sprouted *Senna obtusifolia* seed meal; FSOSM = Fermented *Senna obtusifolia* seed meal

The result for the haematological indices of broiler chickens fed raw or processed *Senna obtusifolia* seed meal-based diet is presented in Table 5. The results indicated non-significant (P>0.05) difference among the treatments except for the packed cell volume (PCV), white blood cells (WBC) count and mean corpuscular volume (MCV). The PCV values of broiler chickens fed 0% *Senna obtusifolia* seed meal-based diet was significantly (P<0.05) higher compared to the chickens fed the processed *Senna obtusifolia* seed meal-based diets. The low PCV values of broiler chickens fed the raw *Senna obtusifolia* seed meal-based diet may be attributed to the negative effects of high concentration of anti-nutritional factors in the raw seeds. Similar observation was made by Igene *et al*. (2012) when they fed processed pigeon pea seed meal to broiler chickens. The PCV value of 32.83% of broiler chickens fed 0% SOSM is close to the normal range of 35.90 to 41% reported by Wikivet (2013). The PCV values of the chickens fed raw or processed *Senna obtusifolia* seed meal-based diets which ranged from 23.1 to 29% is lower than the normal range of 35.90 to 41% reported by Wikivet (2013). Igene *et al*. (2012) pointed out that PCV value measures the percentage composition of blood cells in relation to other contents such as plasma

Table 5: Haematological Indices of Broiler Chickens Fed Graded Levels of Raw or Processed *Senna obtusifolia* Seed Meal-based Diet

	Level of inclusion of the raw or processed SOSM						
Parameters	**T1(0%) SOSM**	**T2(20%) RSOSM**	**T3(20%) BSOSM**	**T4(20%) SKSOSM**	**T5(20%) SPSOSM**	**T6(20%) FSOSM**	**SEM**
PCV (%)	32.83[a]	25.54[c]	28.70[b]	29.11[b]	27.50[b]	28.90[b]	0.21*
Hb (g/dl)	9.27	9.07	8.70	8.80	7.96	8.60	0.21[NS]
RBC ($x10^6$/ml)	2.47	2.37	2.26	2.38	2.25	2.32	0.21 [NS]
WBC$x10^3$/ml)	2.34[b]	2.71[a]	2.50[b]	2.30[b]	2.40[b]	2.20[b]	16.98*
MCV (fl)	132.91[a]	97.47[b]	126.99[b]	122.31[b]	122.22[b]	124.56[b]	2.52*
MCH (pg)	37.53	38.27	38.50	36.97	35.38	37.07	2.74[NS]
MCHC (%)	28.23	32.93	30.31	30.23	28.95	29.76	1.84[NS]

a, b, c = Means in the same row with different superscripts are significantly different at 5% level of probability; NS = Not significant (P>0.05); SEM = Standard error of the means; PCV = Packed cell volume; Hb = Haemoglobin concentration; RBC = Red blood cells; WBC = White blood cell; MCV = Mean corpuscular volume; MCH = Mean corpuscular haemoglobin; MCHC = Mean corpuscular haemoglobin concentration; SOSM = *Senna obtusifolia* seed meal; RSOSM = Raw *Senna obtusifolia* seed meal; BSOSM = Boiled *Senna obtusifolia* seed meal; SKSOSM = Soaked *Senna obtusifolia* seed meal; SPSOSM = Sprouted *Senna obtusifolia* seed meal and FSOSM = Fermented *Senna obtusifolia* seed meal.

and food nutrients. They further explained that PCV is very useful in assessing the normal blood level in the body of an animal. With regard to this finding, broiler chickens fed the neutral diet (0% SOSM) exhibited better PCV values compared to the broiler chickens fed the processed *Senna obtusifolia* seed meal-based diets an indication of the negative effects of the residual anti-nutritional factors.

The red blood cells (RBC) count and haemoglobin (Hb) concentration, mean corpuscular heamoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) of broiler chickens fed the experimental diets were not significantly (P>0.05) affected by the dietary treatments. According to Nse *et al*. (2014), a decrease in the quantity of RBC and Hb are indications of poor nutrition especially dietary deficiencies of iron, copper, vitamins and amino acids. The similarity of the values in the RBC, Hb, MCH and MCHC with that of the control diet (0% SOSM) reflects the adequacy of the nutrients in the diets and the effectiveness of the processing methods in improving the utilization of SOSM by the chickens. The RBC counts which ranged from 1.88 to 2.47 X 10^3/ml is close to the value of 2.85% reported by Isidahomen *et al*. (2011) for broiler chickens in the tropics.

The Hb values of the chickens which ranged from 7.96 to 9.27 g/dl is however; close to the normal range of 11.60 to 13.68 g/dl reported by Wikivet (2013). The WBC and RBC counts values showed significant variation (P<0.05) with those chickens fed the unprocessed SOSM having the highest WBC count an indication of increased antibody levels to counteract the harmful effects of the anti-nutritional factors. This finding is in agreement with the report of Apata *et al*. (1990) who stated that increased WBC count may be due to immunological response to anti-nutritional factors in the body of the birds. The similarity observed in the WBC count of the broiler chickens in the positive control group (T1 0% SOSM) and the chickens fed the processed *Senna obtusifolia* seed meal-based diets revealed that the processing methods were effective in detoxifying the anti-nutritional factors present in the

seed meal thus resulting in better immunological response of the chickens. The WBC counts recorded in this study were all lower than the range of 4.07-4.32 x 10^3/ml reported by Wikivet (2013) except for those fed the RSOSM.

The results of the erythrocytic indices such as MCV, MCH and MCHC of the broiler chickens fed the experimental diets revealed non-significant (P>0.05) difference except for the MCV. The MCV value of broiler chickens fed 0% SOSM was better compared to other treatment groups. This might be due to the negative impact of the residual anti-nutritional factors present in the processed SOSM. However, the MCV, MCH and MCHC obtained in this study are all close to the normal values of 133.86 fl, 44.53 pg and 33.21% reported by Isidahomen *et al*. (2011). A decrease in erythrocytic indices such as MCHC indicates iron deficiency and macrocytic anaemia (Ochei and Kolhatkav, 2007). With respect to this findings, the

chickens did not suffer from iron deficiency that might result to anemic condition.

The result of the serum biochemical parameters of broiler chickens fed with raw or processed *Senna obtusifolia* seed meal based-diets are presented in Table 6.

Table 6: Serum Biochemical Indices of Broiler Chickens Fed Raw or Processed *Senna obtusifolia* Seed Meal-based Diets

	Level of inclusion of the raw or processed SOSM						
Parameters	**T1 (0% SOSM)**	**T2 (20% RSOSM)**	**T3 (20% BSOSM)**	**T4 (20% SkSOSM)**	**T5 (20% SPSOSM)**	**T6 (20% FSOSM)**	**SEM**
Total protein (g/dl)	4.06^{a}	1.97^{b}	3.14^{a}	3.16^{a}	3.37^{a}	4.19^{a}	0.73*
Albumin(g/dl)	2.94^{a}	1.52^{c}	2.15^{a}	1.75^{b}	2.08^{a}	2.90^{a}	1.64*
Globulin (g/dl)	1.12	0.45	0.99	1.41	1.29	1.29	0.24^{NS}
Uric acid (mmol/l)	2.31^{a}	1.20^{c}	1.67^{c}	1.91^{b}	2.37^{a}	1.22^{c}	0.18*
Cholesterol (mg/dl)	68.1^{a}	22.30^{e}	54.5^{b}	32.10^{c}	27.7^{d}	57.60^{a}	10.72*
Creatinine (mmol/l)	57.00^{b}	88.37^{a}	85.33^{a}	84.17^{a}	88.33^{a}	63.85^{b}	5.76*
Calcuim (mmol/l)	5.86^{a}	2.17^{c}	3.35^{b}	3.21^{b}	3.19^{b}	3.74^{b}	1.62*
Phosphorus (mmol/l)	3.20^{a}	2.07^{c}	2.97^{b}	2.73^{b}	2.89^{b}	2.61^{b}	1.71*
Potassium (mmol/l)	180.80^{a}	98.80^{f}	145.67^{e}	153.07^{d}	165.00^{c}	172.00^{b}	11.17*
Sodium (mmol/l)	161.67^{a}	77.47^{e}	135.00^{c}	84.19^{d}	79.42^{d}	153.57^{b}	10.08*
Chloride Cl^{-}(mmol/l)	67.83^{a}	43.57^{c}	68.23^{a}	50.10^{b}	52.40^{b}	65.66^{a}	8.99*
Bicarbonate (mmol/l)	21.50^{a}	13.05^{c}	18.40^{b}	14.10^{c}	17.03^{b}	20.53^{a}	1.67*
Alkaline phosphatase (iμ/l)	34.33^{c}	64.33^{a}	44.43^{b}	40.03^{b}	44.67^{b}	35.27^{b}	4.33*
AST (μ/l)	6.33^{c}	9.27^{a}	7.74^{b}	8.92^{a}	8.81^{a}	6.07^{c}	0.90*
ALT (μ/l)	5.18^{c}	8.53^{a}	5.40^{c}	7.52^{a}	6.27^{b}	5.60^{c}	0.73*
TB (mmol/l)	5.43^{c}	16.38^{a}	4.43^{c}	11.13^{b}	14.63^{ab}	11.17^{b}	1.62*
CB (mmol/l)	2.76^{c}	7.82^{a}	2.86^{c}	4.43^{b}	7.81^{a}	4.07^{b}	1.77*

a, b, c, d, e = Means in the same row with different superscripts are significantly different at 5% level of Significance; NS = Not significant SEM = Standard error of the means; AST = Aspartate amino transferase; ALT = Alanine amino transferase; TB = Total bilirubin; CB = Conjugated bilirubin; SOSM = *Senna obtusifolia;* RSOSM = Raw *Senna obtusifolia* seed meal; BSOSM = Boiled *Senna obtusifolia* seed meal; SkSOSM = Soaked *Senna obtusifolia* seed meal; SPSOSM = Sprouted *Senna obtusifolia* seed meal; FSOSM = Fermented *Senna obtusifolia* seed meal

The total protein and albumin values were significantly (P<0.05) affected by the dietary treatments. The total protein and albumin values were significantly (P<0.05) lower in the group of broiler chickens fed the raw *Senna obtusifolia* seed meal–based diet compared to those fed the positive control and the processed *Senna obtusifolia* seed meal-based diets. The value for total protein of the broiler chickens fed RSOSM was lower than the normal range of 4.63 to 4.81g/dl reported by Wikivet (2013). The decreased in the values of total protein and albumin are indications of inadequate protein utilization and also liver impairment resulting to low synthesis and production of albumin. This is in tandem with the report of Thapa,. and Walia (2007) Who explained that low production of albumin is an indication of liver damage or injury.

The different processing methods used were observed to reduce the levels of the anti-nutritional factors which resulted in better protein utilization in broiler chickens fed the processed seed meal-based diets. This is reflected by the closeness of the values for the total protein to the normal range of 4.63 to 4.81g/dl reported by Wikivet (2013). This finding is contrary to findings of Emiola *et al*. (2013) who in a similar study fed differently processed legume seed meal to broiler chickens and reported no effect on total protein. However, values for total protein, albumin and globulin of broiler chickens fed the fermented *Senna obtusifolia* seed meal-based diet indicated better status compared to the broiler chickens fed the other processed seed meals. This trend revealed the effectiveness of fermentation compared to other processing methods. Tuleun *et al*. (2011) also made similar observation for broiler chickens fed fermented mucuna seed meals. The differences observed in the performance of broiler chickens fed the processed *Senna obtusifolia* seed-meal based diets were possibly due to variations in the concentration of residual anti-nutritional factors as earlier reported by Emiola *et al*. (2013).

The serum uric acid levels of the broiler chickens were significantly (P<0.05) higher in the broiler chickens fed the raw and sprouted *Senna obtusifolia* seed meal-based diets compared to other groups. Rise in uric acid levels are linked to poor protein quality, utilization and kidney abnormalities. The high concentration of anti-nutritional factors in the raw seed meal and the sprouted seed meal might have been responsible for this observed effect. Abiola *et al*. (2001) further buttressed that increase in urea concentration is an indication of poor protein quality. Reed *et al*. (1995) pointed out that tannins in feed can led to poor protein utilization. In addition, elevated levels of uric acid is an indication of kidney abnormality which is connected to the adverse effects of anti-nutritional factors in the raw seeds.

This findings was supported by the report of Thapa and Walia (2007) who pointed out that increase level of uric acid is a pointer towards kidney injury.

The cholesterol levels of the broiler chickens fed the dietary treatments revealed significant (P<0.05) differences among the treatment groups. Broiler chickens fed the control diet (0% SOSM), boiled and fermented *Senna obtusifolia* seed meal-based diets showed significantly (P<0.05) higher cholesterol levels compared to the other treatment groups. This is due to the reduction of the anti-nutritional factors such as tannins, phytates and oxalates by the processing methods used. Anti-nutritional factors have been reported to reduce fats and cholesterol levels in tissues (Zunft, *et al*., 2003). The possible cholesterol lowering effect was contributed by the presence of high concentrations of anti-nutritional factors in the raw, soaked and sprouted seeds. The cholesterol values which ranged from 22.30 to 68.10 g/dl were lower than the value of 89.78 mg/dl reported by Isidahomen *et al*. (2011) who fed sorrel seed meal to broiler chickens.

The levels of creatinine indicated significant (P<0.05) variations with the broiler chickens fed the raw and sprouted seed meal having higher values. These high values are signs of kidney abnormality possibly caused by the toxic components present in the raw or sprouted seed meals. Creatinine levels have been reported to be used as a biochemical markers employed in the diagnosis of renal related problems (Ojediran *et al*., 2012). The creatinine levels obtained in this study which ranged from 57.0 to 88.37 mmo/l is higher than the value of 44 mmol/l reported by Isidahomen *et al*. (2011)

The electrolyte constituents of broiler chickens fed the experimental diets showed significant (P<0.05) difference. The electrolyte constituents were significantly (P<0.05) lower in broiler chickens fed the raw *Senna obtusifolia* seed meal-based diets when compared to those fed the positive control diet and the processed *Senna obtusifolia* seed meal-based diets. The values of calcium for broiler chickens fed the RSOSM are lower than the normal values of 9.34 mg/dl for calcium and 4.14 mg/dl for phosphorus reported by Melody *et al*. (2012). The better electrolyte values recorded in broiler chickens fed the processed seed meal-based diets may be due to the reduction of the anti-nutritional factors by the processing methods which might have enhanced efficient utilization of minerals by the chickens.

It is important to note that the presence of phytate in biological systems may chelate divalent metals like calcium, magnesium sodium potassium and phosphorus or block the absorption of essential minerals in the intestinal tract (Dan, 2005), thus affecting their availability in the body of animals. Ekeanyanwu *et al*. (2010) further reported that phytate can chelate mineral elements thereby affecting their utilization. Savage (1993) also reported the adverse effects of oxalate on calcium utilization. These authors explained that oxalates can remove calcium from the blood in form of calcium oxalates which may block renal tubules resulting to kidney damage.

The values for alkaline phosphatase of the broiler chickens fed the experimental diets were significant ($P<0.05$) affected by the dietary treatments. The values recorded in the chickens fed 0% SOSM and the processed *Senna obtusifolia* seed meal-based diets were similar and lower than the values of those fed the raw seed meal-based diets. The significant ($P<0.05$) increase in the level of this enzymes in broiler chickens fed the raw SOSM might be connected to the adverse effects of the anti-nutritional factors on the liver of the chickens. This strongly agreed with the findings of Akinmutimi and Onen (2008) who fed broiler chickens with yam peel meal and observed an increase in the levels of alkaline phosphatase.

The results for the hepatic enzymes, aspartate aminotransferase (AST) and alanine aminotransferase (ALT) showed significant variations which also presented similar elevated levels and attributes as that of the alkaline phosphatase. This is an indication that the broiler chickens fed the raw seed meal might have suffered from certain liver problems. However, the broiler chickens fed the control diet (T1, 0%SOSM), boiled and fermented *Senna obtusifolia* seed meal-based diets recorded lower ALT values which are relatively close to the normal value of 10.20 µ/l reported by Bahman *et al*. (2014). This revealed that the boiling and fermentation methods used were effective in reducing the levels of the anti-nutritional factors present in *Senna obtusifolia* seed meal.

The values for total and conjugate billirubin of the broiler chickens fed the experimental diets were significantly ($P<0.05$) affected by the diets. The broiler chickens fed the raw, soaked and sprouted *Senna obtusifolia* seed meal-based diet recorded higher ($P<0.05$) values indicating adverse effect of anti-nutritional factors on the liver. This is in line with the report of Howard (2009) who reported that high levels of billirubin in blood is a reflection of liver damage and progressive impairment. This is connected to the adverse effects of residual anti-nutritional factors present in the raw, soaked and sprouted *Senna obtusifolia* seed meal. The lower levels of billirubin in broiler chickens fed the boiled and fermented *Senna obtusifolia* seed meal-based diets revealed the effectiveness of these processing methods in reducing the levels of these anti-nutritional factors.

Conclusion

The outcome of this study revealed that raw *Senna obtusifolia* seed meal had deleterious effects on some haematological and biochemical parameters of broiler chickens. However, better haematological and biochemical parameters were recorded in broiler chickens fed the processed *Senna obtusifolia* seed meal-based diets. The chickens fed the fermented Seed meal-based diets indicated better haematological and biochemical parameters when compared to the broiler chickens fed the boiled, soaked and sprouted *Senna obtusifolia* seed meal-based diets. Inclusion of 20% fermented *Senna obtusifolia* seed meal is therefore recommended for feeding of broiler chickens.

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