Performance of Broiler Chickens Served Heat Treated Fluted Pumpkin 
(*Telfaria occidentalis*) Leaves Extract Supplement


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**Abstract:** Performance of broiler chickens served heat treated fluted pumpkin (*Telfaria occidentalis*) leaves extract (FPLE) was investigated. The experiment was carried out during the early rainy season of 2005. One hundred and twenty five day-old chicks of Anak 2000 were weighed and randomly distributed to five dietary treatments A, B, C, D and E which contained no FPLE (control), fluted pumpkin leaves (FPL) no heat treatment, FPL immersed in hot water (100°C) for 1 minute, FPL immersed in hot water (100°C) for 3 minutes and FPL immersed in hot water (100°C) for 5 minutes, respectively. Each treatment was replicated 3 times in a completely randomized design. The broiler starters (BS) were fed the same starter diet, while broiler finishers (BF) were equally fed the same finisher diet. Water and feeds were served *ad-libitum*. Data collected were subjected to one-way ANOVA and comparisons were made using Duncan’s Multiple Range Test. The FPLE is a valuable protein and mineral supplement for broiler chickens. One to five minutes heat (100°C) treated FPLE reduced the concentrations of phytate and tannin by 13.51-24.32 and 5.26-7.89%, respectively. One to five minutes heat treatment had no effect on the reduction of saponin. The most available deleterious substance was saponin (0.250 – 0.281g/100gDM). The results revealed that FPLE served to the birds had significant (P<0.05) effect on feed intake (FI), weight gain (WG), feed conversion ratio (FCR), protein efficiency ratio, water intake (WI) and cost of feed per kilogramme live weight (CFPKLGW). Birds served FPLE in both phases had reduced FI which was 7.30 and 21.89% for BS and BF, respectively compared to control. The best WG was in treatment D in both phases which was 594.55 and 1350.53g/bird, respectively for BS and BF compared to control (565.00 and 1287.03g/bird). The CFPKLGW was best for the birds in treatments D and E for BS and treatments B, C and D for BF. The FCR for birds in treatments B, C and D was averagely 2.77 compared to control (3.11) and treatment E (2.90) for BF. It is advisable to serve broiler chickens 1-3 minutes heat (100°C) treated FPLE for improved WG, FCR and CFPKLGW during early rainy season in humid tropical environment.

**Key word:** Performance, broiler chicken, heat treated fluted pumpkin leaves extract

**INTRODUCTION**

The poor state of economy in developing countries has made consumption of high protein foods out of reach of more than 65-70% of the people[32]. One of the ways of solving this problem is to use unconventional sources of protein and leaf protein to supplement the diets of man and farm animals. Studies on leaf protein have shown their potential for supplying good quality food proteins greater than would be obtained with cereals, legumes and oil seeds[22]. The authors noted that not all leaf proteins are good quality and that those that produce a weight gain of 25g in four weeks when fed to laboratory animals are generally regarded as good quality protein. One of such vegetables is fluted pumpkin (*Telfaria occidentalis*) which is widely cultivated in the tropics and subtropics. The protein from leaves may be recovered and fed to farm animals as solution in form of protein concentrates[25].

*Telfaria occidentalis* leaves extract is regarded as blood tonic in Nigeria, where it is taken either solely or with addition of honey, or milk for stressed and anaemic patients[32]. Nutritive values of the leaves of fluted pumpkin (FP) have been evaluated chemically and found to contain (g/100g DM) 30.5±2.50 crude proteins, 3.0±0.15 crude lipid, 8.3±0.50 crude fibre and 8.4±0.50 total ash [29]. The authors noted that the leaves of FP had low levels of tannic acid (0.05g/100gDM), oxalate (0.005g/100gDM) and phytic
acid (0.020g/100gDM). These authors further reported that FP leaves were rich in potassium, calcium and magnesium, whose values were 0.594, 0.144 and 0.100% respectively. Leafy vegetables supply minerals, proteins and vitamins, thereby complementing the inadequacies of most foodstuffs [24]. Fluted pumpkin is a leafy vegetable called Ugu in Igbo, Gbaroko in Yoruba and Umeke in Edo.

Adedapo et al.[2] used FP and sorghum bicolor extracts as potent haematinics in domestic rabbits and reported that the rabbits served these extracts had the highest values of packed cell volume (PCV), haemoglobin (Hb), red blood and white blood cells and faster responded to theraphy. Bashar and Abubakar[12] observed that feed intake and weight gain of broilers decreased with increase in FP seed meal dietary inclusion. Nworgu et al.[31] reported that broiler chicken served 60mlFPLE/litre of water had improved feed intake, higher weight gain, elevated PCV, Hb and RBC over control and 120mlFPLE/litre of water.

Major problem of leaf meal and leaves extract utilization in monogastric nutrition is the presence of deleterious substances such as lectins, alkaloids, tannins, saponins, protease inhibitors, phytate, among others[19]. Mendoza and del Rosario[10] recommended soaking the leaves in water at 70°C for 10 minutes, while Abeke et al.[1] recommended 20 minutes cooking beans of Lablab purpureus. Oduguwa et al.[33] reported that autoclaved whole pods of Samanea saman (Jacq Merill) at a temperature of 100°C for 15 minutes and fed to domestic rabbits 100g/kg resulted to better feed intake and weight gain compared to the rabbits fed 100g/kg raw Samanea saman diet. Cooking improves nutritive values of legume seeds and brings the values close to that of meat and milk products by destroying some of the anti-nutritional factors[19,8]. Processing improves the utilization of protein and energy of legumes and vegetables[47,27].

Eggs and poultry meats are beginning to make a substantial contribution in relieving the protein insufficiency in African countries[17]. Capital invested in poultry business is quickly realized, most especially in broiler production. However, feed accounts for 65-75% of the total production cost in poultry production in Nigeria[31]. Utilization of FP leaves extract in poultry nutrition for protein and mineral supplement during the dry and rainy seasons is not common in our environment. Hence, the experiment was conducted to evaluate the growth performance of broilers served fluted pumpkin leaves extract (FPLE).

**MATERIALS AND METHODS**

One hundred and twenty five day-old broiler chicks of Anak 2000 were purchased from Amino

<table>
<thead>
<tr>
<th>Table 1: Gross composition of experimental diets of broilers served heat treated fluted pumpkin leaves extract (FPLE).</th>
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</thead>
<tbody>
<tr>
<td>Ingredients (%)</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Maize</td>
</tr>
<tr>
<td>Corn bran</td>
</tr>
<tr>
<td>Palm kernel cake</td>
</tr>
<tr>
<td>Soybean meal</td>
</tr>
<tr>
<td>Groundnut cake</td>
</tr>
<tr>
<td>Fish meal (72%)</td>
</tr>
<tr>
<td>Bone meal</td>
</tr>
<tr>
<td>Vitamin premix (+)</td>
</tr>
<tr>
<td>Salt</td>
</tr>
<tr>
<td>Lysine</td>
</tr>
<tr>
<td>Methionine</td>
</tr>
<tr>
<td>Calculated Analysis</td>
</tr>
<tr>
<td>Crude protein (%)</td>
</tr>
<tr>
<td>Crude fibre (%)</td>
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<tr>
<td>Metabolizable energy (Kcal/kg)</td>
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<tr>
<td>Determined Analysis</td>
</tr>
<tr>
<td>Crude protein (%)</td>
</tr>
<tr>
<td>Crude fibre (%)</td>
</tr>
<tr>
<td>Metabolizable energy (Kcal/kg)*</td>
</tr>
</tbody>
</table>

*Determined by Panzenga[10].

(1) To provide the following per kg of diet: Vit. A = 10,000iu, Vit. D₃ = 2000iu, Vit. E = 5, Vit. K = 2mg, Riboflavin = 4.20mg, Nicotinic acid = 20mg, Vit. B₁₂ = 0.01 mg, Pantothenic acid = 5mg, Folic acid = 0.5mg, Choline = 3mg, Mg = 56mg, Fe = 20mg, Cu = 10mg, Zn = 50mg, Co = 125mg and Iodine = 0.08mg.

Breeder Farm, Ibadan for the research work. The experiment was carried out at Bora Poultry Unit of Federal College of Animal Health and Production Technology, Institute of Agricultural Research and Training (IAR&T) Ibadan, Nigeria. The experiment was carried out during the early rainy season (April-June) of 2005 with mean annual rainfall of 1200mm and mean monthly temperature of 25.4°C. The chicks were weighed and randomly allotted to five dietary treatments A, B, C, D and E which contained no fluted pumpkin leaves extract (FPLE) (control), fluted pumpkin leaves (FPL) no heat treatment, FPL immersed in hot water (100°C) for 1 minute, FPL immersed in hot water (100°C) for 3 minutes and FPL immersed in hot water (100°C) for 5 minutes, respectively. The FPLE was served at three days interval throughout the period of the experiment (8 weeks, i.e. 4 weeks for each phase) at a concentration of 60ml per litre of water. The birds were served the FPLE according to the treatments per litre of water and later water was served ad-libitum as well as feed (Table 1).

The birds were fed the same starter diet, while the birds in all the treatments at finisher phase were equally fed the same finisher diet (Table 1). Each treatment was replicated three times in a completely randomized design and the finisher phase was a direct carry over from the starter phase. Routine management practices, vaccinations and drugs were administered as at when due.
Data Collection: Data on the feed and water intake were taken on daily basis, while weight gain was determined on weekly basis and feed conversion ratio was calculated at the end of each phase. The protein efficiency ratio (PER) was gotten by dividing mean body weight gain by the mean protein consumed.

Preparation of Fluted Pumpkin Leaves Extract: One kilogramme of freshly cut fluted pumpkin leaves with stalk was divided into four at the rate of 250g per treatment. It was washed, drained and tied with a string and immersed in hot water at 100°C for one, three and five minutes and later drain and chopped and pounded in a mortar with pestle. This was then squeezed and filtered with a sieve to obtain a homogenous extract of the FPL. The homogenous FPLE was prepared at three days interval and served the birds fresh according to the treatments. The FPL is an exotic vegetable in Nigeria, which the women avoid boiling, they rather steam it to avoid nutrients loss.

Proximate and Chemical Analyses: Proximate and mineral composition of the test ingredient were determined according to the procedures of Boehringer[14] and AOAC[9] and proximate composition of the diets was determined by the methods of AOAC[9], while the metabolizable energy was determined by the method outlined by Panzenga[48] and the gross energy was estimated by the procedures of AFRC[3]. Phytate was determined by the technique of Igbedioh et al.[21], while tannin was evaluated by the method outlined by Hagerman and Ler[23], oxalate by the procedures of Talapatra and Price[31], while saponin was determined according to the procedures of Sofowora[57].

Statistical Analysis: Data collected were subjected to analysis of variance (ANOVA) and the errors were calculated as standard errors of the mean (SEM). Significant treatment means were compared using Duncan’s New Multiple Range Test as outlined by Obi[18]. Significance was accepted at the 0.5 level of probability.

RESULTS AND DISCUSSIONS

The results of the proximate chemical composition of the heat treated fluted pumpkin leaves extract (FPLE) are presented in Table 2. The results depicted FPLE as rich in crude protein (19.96 – 20.74%), ash

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Fresh FPLE</th>
<th>Fluted Pumpkin Leaves immersed in hot water for 1 minute</th>
<th>Fluted pumpkin leaves immersed in hot water for 3 minutes</th>
<th>Fluted pumpkin leaves immersed in hot water for 5 minutes</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter</td>
<td>86.84</td>
<td>87.96</td>
<td>87.28</td>
<td>86.16</td>
<td>0.16</td>
</tr>
<tr>
<td>Crude protein</td>
<td>19.96</td>
<td>20.74</td>
<td>20.48</td>
<td>20.65</td>
<td>0.06</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>5.62</td>
<td>5.74</td>
<td>5.68</td>
<td>5.71</td>
<td>0.03</td>
</tr>
<tr>
<td>Crude fat</td>
<td>1.19</td>
<td>1.26</td>
<td>1.21</td>
<td>1.18</td>
<td>0.04</td>
</tr>
<tr>
<td>Ash</td>
<td>12.69</td>
<td>12.48</td>
<td>12.36</td>
<td>12.43</td>
<td>0.05</td>
</tr>
<tr>
<td>Nitrogen free extract</td>
<td>60.54</td>
<td>59.78</td>
<td>60.27</td>
<td>60.03</td>
<td>0.14</td>
</tr>
<tr>
<td>Grossenergy (Kcal/kg)*</td>
<td>4032</td>
<td>4056</td>
<td>4055</td>
<td>4053</td>
<td>0.07</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.47b</td>
<td>0.53a</td>
<td>0.44c</td>
<td>0.57a</td>
<td>0.02</td>
</tr>
<tr>
<td>Potassium</td>
<td>0.37</td>
<td>0.42</td>
<td>0.39</td>
<td>0.36</td>
<td>0.03</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.27</td>
<td>0.31</td>
<td>0.24</td>
<td>0.33</td>
<td>0.06</td>
</tr>
<tr>
<td>Sodium</td>
<td>0.26</td>
<td>0.21</td>
<td>0.25</td>
<td>0.28</td>
<td>0.01</td>
</tr>
<tr>
<td>Iron (mg/kgDM)</td>
<td>12.80d</td>
<td>13.30c</td>
<td>13.50b</td>
<td>13.70a</td>
<td>0.05</td>
</tr>
<tr>
<td>Phytate (g/100g DM)</td>
<td>0.037a</td>
<td>0.032b</td>
<td>0.029c</td>
<td>0.030c</td>
<td>0.001</td>
</tr>
<tr>
<td>Oxalate (g/100g DM)</td>
<td>0.039d</td>
<td>0.043c</td>
<td>0.047a</td>
<td>0.045b</td>
<td>0.002</td>
</tr>
<tr>
<td>Tannin (g/100g DM)</td>
<td>0.038a</td>
<td>0.036b</td>
<td>0.036b</td>
<td>0.035c</td>
<td>0.002</td>
</tr>
<tr>
<td>Saponin (g/100g DM)</td>
<td>0.250c</td>
<td>0.280a</td>
<td>0.281a</td>
<td>0.270b</td>
<td>0.100</td>
</tr>
</tbody>
</table>

*Estimated by AFRC (1990)

abcd: Means with different superscripts on the same horizontal row differ significantly (P<0.05).
with the results of Ladeji et al. The concentration of phosphorus and iron reported in the present study are similar to those reported by Ladeji et al. The concentration of phosphorus (0.040%) and potassium (0.020g/100gDM) were significantly affected by the heat treatment (Table 2). One to five minutes heat treatment reduced the concentrations of phytate and tannin by 13.51-21.62 and 5.26-7.89%, respectively, while the concentrations of oxalate and saponin were not significantly reduced by heat treatment (Table 2). Broiler starter (BS) and broiler finisher (BF) diets presented in the present study met the nutritional requirement of the birds and are in line with the standards of NRC. The FPLE either heat-treated or not in this study is rich in crude protein (CP), phosphorus, potassium, sodium, iron and calcium with concentration of 5.62-5.74%. Tannin, oxalate and phytate are very low when compared to leguminous leaves. Hence the FPLE is a very good feed/food supplement for farm animals/man. In Nigeria, anaemic patients and pregnant women are recommended to take the leaves extract by the medical personnel. As an exotic vegetable, in order to improve its nutritive value, we decided to apply 1-5 minutes heat at 100°C. Heat treatment increased the concentration of CP and CF though not significant. However, Ladeji et al. reported lower concentrations of these chemicals whose values were 0.005, 0.05 and 0.020g/100gDM, respectively for oxalate, tannin and phytate. Low concentration of these deleterious substances accounts for low heat treatment (steaming) of this vegetable before eating unlike the seeds of the same vegetable that requires 2-3 hours of cooking before consumption. Akanji et al. reported that aqueous heating destroyed 92.6 and 84.91% of heamagglutinin and trypsin inhibitor in jackbean (Canavalia ensiformis) seeds. The reduction of the concentrations of phytate (13.15 –24.32%) and tannin (5.21 –7.89%) in this study is similar with the observation of Akanji et al. who noted that phytate and tannin contents of jackbean were partially affected by heat treatment, whose reduction values varied from 13.84 –23.08 and 33.33 –41.03%, respectively. These authors highlighted that phytate was more heat stable, although 41.03% loss of tannin was due to 48 hours soaking in excess cold water followed by decortication and cooking for 2 hours. Tannin and phytate have been reported to be heat stable. The lower percentage loss in phytate (13.51 –24.32) of the aqueous – heated FPLE could be ascribed to the strong electrostatic force that existed between oxygen atoms of contiguous phosphate radicals within the phytate structure, as earlier confirmed by O’Dell and de Boland. The lower percentage loss of tannin content (5.26–7.89) of the FPLE could be attributed to a likely leaching of a small fraction of hydrolysable phenolic compounds located in the cell walls of the FPL. Similar observation was made by Bressani et al. about fermented and aqueous – heated jackbean. Reduction of tannin in this study is in line with observation of Ologbo[41] for lima beans Oke et al. for cowpea and Kaankuta et al. for soybean. Bawa et al. reported a linear significant
(P< 0.05) decrease in the concentration of tannic acid with increase in the duration of cooking. Bawa et al.[11] reported that the rate of destruction of phytic acid in lablab (Lablab purpureus) seeds was very low (17.52%) at 15 minutes cooking and 31.33% at 30 minutes cooking. The reduction of concentrations of phytate and tannin corroborates with the findings of Apata[10]. Fagbemi et al.[12] reported that fermentation is the most effective processing methods of reducing phytic acid and trypsin inhibitor, while boiling is most effective in reducing the tannic acid content. Ologhobo and Fetuga[44] reported that loss of phytic acid was due to its solubility in processing water during cooking. One to five minutes heat treatment (100°C) had no effect on the oxalate and saponin concentrations. This could be associated with little time of heat application. Hence, the bitterness of saponin can not be reduced by 1-5 minutes heat treatment, may be soaking the leaves in cold water or hot water for longer time will lead to the reduction of the concentration of saponin, as soaking in cold water with squeezing is commonly used to reduce drastically the concentration of saponin in Vernonnia amygdalina[6].

The performance indices of broiler starters and finishers served heat treated (HT) FPLE are presented in Table 3 and Figure 1. The final body weight (FBW),

![Table 3: Performance of Broilers Served Heat Treated Fluted Pumpkin Leaves Extract](image-url)
weight gain (WG), feed intake (FI) and protein efficiency ratio (PER) were significantly \( (P<0.05) \) affected in both phases, while only total water intake (TWI) and feed conversion ratio (FCR) were significant \( (P<0.05) \) at finisher phase (FP). At starter phase (SP), the best FBW (629.55g/bird) and WG (594.55g/bird) were observed on the birds served 3 minutes heat treated FPLE, while the least of these parameters were obtained in control Table 3 and Figure 1. Similar scenario was observed at FS. Birds served the FPLE either heat treated or not had reduced feed intake in both phase. Increased water intake (WI) was only recorded on the broiler finishers served 3-5 minutes heat treated FPLE. Dietary inclusion of FPLE significantly \( (P<0.05) \) improved the PER in both phases. The cost of feed per kilogramme live weight gain (CFPKLGW) was best on the birds served 3-5 minutes heat treated FPLE (treatments D and E) at SP (N141.09-N142.18/kg) as against N154.37/kg in control. Similar trend was also observed at FP. The relative cost advantage was also best in treatments D and E (5.63-6.14%) compared to no heat treatment (1.60%), while the best of this parameter at finisher phase was in treatment C (14.37%) compared to 5.83% in treatment E. Mortality of 8-12% was recorded at starter phase (Table 3). The utilization of heat treated FPLE had significant \( (P<0.05) \) effect on the FI, FBW, WG, FCR, PER, TWI and CFPKLGW of the broiler chickens. The FI in this study at starter phase (SP) \((1331.07 -1498.21\text{g/bird})\) is similar with the reports of Nworgu et al.\(^{[33]}\) \((1136 –1375\text{g/bird})\) and lower than that reported by Ayanwale\(^{[31]}\) \((1003–1004\text{g/bird})\). At finisher phase (FP), the FI in this study \((3089.29 –3621.43\text{g/bird})\) is in harmony with the submission of Nworgu et al.\(^{[34]}\) \((3120.60–3262.10\text{g/bird})\) but lower than reports of Esonu et al.\(^{[19]}\) \((3668-4200\text{g/bird})\). The WG in the present study for BS \((550.00 –594.55\text{g/bird})\) is slightly lower than the submission of Nworgu et al.\(^{[33]}\) \((676.50 –751.50\text{g/bird})\), while at FP, the WG \((1198.50 –1350.53\text{g/bird})\) is slightly higher than the results of Etuk et al.\(^{[20]}\) \((1000.00–1100.00\text{g/bird})\) and within the average value \((1261.33\text{g/bird})\) reported by Esonu et al.\(^{[19]}\). The FCR in both phases is lower than the revelation of Etuk et al.\(^{[20]}\) \((1.50–2.07\text{)}. The FI in both phases decreased with the inclusion of FPLE in both non- and heat treated. This indicates the presence of deleterious substances (tanini, saponin, phytate and oxalate). The best WG in both phases was observed on the birds served 3 minutes heat treated FPLE. Bashar and Abubakar\(^{[12]}\) reported decreased FI and depressed WG when broiler chickens were fed 30% fluted pumpkin seed meal. Utilization of PLE improved FCR and PER. The PER in this study is similar with the reports of Akanji et al.\(^{[5]}\) \((1.84 –2.51\text{)}\) and Etuk et al.\(^{[20]}\) \((1.50 –2.07\text{) for broiler chicks and BF, respectively.\)

Better performance of the broiler chickens served 3 minutes heat treated FPLE could be attributed to the availability of more nutrients and minerals due to the breaking of cell walls of FPL. The 5 minutes heat treatment \((100^\circ\text{C})\) could not have positive effects on FI and WG due to erosion or leaching of some nutrients, which made saponin and other deleterious substances more available. Cheke and Shull\(^{[16]}\) concluded that reduction in FI in poultry, rabbits and swine occurred due to unpalatability and poor acceptability of alfalfa leaf meal, which contained saponin that had pronounced bitter taste and irritating effect on the membranes of the mouth and throat of the animals.
Reduction in growth has also been noted when *Sesbania sesban* leaf meal (saponin 7.1gkg⁻¹) (0.71g/100gDM), was incorporated in chicks diet[50]. Bawa et al.[13] noted that cooking lablab seeds beyond 45 minutes resulted to protein denaturation. Hence, to maintain the nutritive values of FPL, it is not advisable to steam it or to heat treat (100°C) it more than 3 minutes. However, tannin and phytate have been reported to from complexes with dietary protein, thereby inhibiting protein metabolism and utilization in monogastric animals[54]. Tannin strongly inhibits digestive enzymes and birds praline rich proteins in the saliva[63,20]. Phytic acid has been reported to cause reduced absorption of Ca from the gastrointestinal tract. Oke[46] reported that zinc and iron deficiency symptoms have occurred in man and chicken when fed diets high in phytic acid. Akindahunsi and Salawu[6] reported that only tannins and saponins are present in 14 tropical green leafy vegetables screened. These authors noted that saponin though non-toxic exhibits cytotoxic effects and growth inhibition against a variety of cells making it to have anti-inflammatory and anticancer properties. AICR[46] noted that saponin showed tumour – inhibiting activity in animals.

Daily water intake (DWI) in this study varied from 77.69 – 79.97 and 258.99 – 268.75ml/bird for BS and BF, respectively. The DWI, for BS is in harmony with the report of Sainsbury[49] (70-100m/bird/day), but for BF his result is lower (140ml/bird/day). Variations could be attributed to type of bird, season, test ingredients and environment the experiment was carried out. The feed water intake ratio reported here agrees with the submission of Oluyemi and Roberts[46]. The best PER in the birds served FPLE was as a result of availability of both micro and macro elements which aided digestion, absorption and utilization[46,18]. The results of CFPKLWG in this study is higher that the report of Nworgu[42] for BS (N114.79g/kg) and N90.66-N94.70/kg for BF. Higher CFPKLWG is due to increased cost of feeds and feed ingredients in Nigeria, most especially the season the experiment was conducted. The best relative cost advantage of CFPKLWG plus cost of FPLE was on treatment D and E for SP and treatments B, C and D for FP. Reduction of FI in both phases for the broilers served FPLE could be associated with the presence of anti- nutritional factors[14] and it could be attributed to the availability of more nutrients as the FPLE is rich in protein and minerals[29,31]. However, the increased water intake in the birds served 3 – 5 minutes heat treated FPLE at FP could be due to availability of more minerals[46] and the heat that level was able to break down more cell walls of the FPL. The mortality recorded at SP was as a result of *Aspergilosis* caused by *Aspergillus falcus*.

**Conclusion:**

- The FPLE is a good protein and mineral supplement for broiler chicken.
- Heat treatment made more phosphorus and iron more available.
- Heat (100°C) treatment of FPLE for 1-5 minutes reduced the concentration of phytate and tannin by 13.51–2432 and 5.26–7.89%, respectively. One to five minutes heat (100°C) treatment had no effect on the concentrations of oxalate and saponin.
- Generally, broiler chickens offered FPLE with or without heat treatment performed better than control in terms of WG, PER and FCR.
- The broiler chickens served FPLE either heat treatment or not had reduced feed intake in both phases.
- If BF are to be offered 3 minutes heat (100°C) treated FPL, more cool drinking water needs to be provided for the birds.

Base on the parameters on the FI, WG, FCR, PER, CFPKLWG, it is advisable to serve broiler starters 3 minutes heat (100°C) treated FPLE, while for broiler finishers 1 – 3 minutes heat (100°C) treated FPLE.

**REFERENCES**


