Haematology, Blood Chemistry and Carcass Characteristics of Growing Rabbits Fed Grasshopper Meal as a Substitute for Fish Meal

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ABSTRACT
An experiment was conducted to evaluate the effect of replacing fish meal with grasshopper meal on haematology, blood chemistry and carcass characteristics of growing rabbits. Forty rabbits of mixed breeds, aged 6-10 weeks, were randomly assigned to the dietary treatments in a complete randomized design with eight rabbits per treatment. The rabbits were fed with diets containing 0, 1.25, 2.50, 3.75 and 5% grasshopper meal in diets designated as T1 (control), T2, T3, T4 and T5, respectively. The experimental diets and clean drinking water were supplied ad libitum throughout the experimental period of nine weeks. At the end of the feeding trial, three rabbits per treatment were slaughtered for carcass evaluation, while blood samples were collected for analysis. The result of the experiment showed significant differences (P<0.05) among the treatments for packed cell volume (PCV), red blood cell count (RBC), white blood cell count (WBC), mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) but there was no significant effect (P>0.05) on haemoglobin and mean corpuscular haemoglobin concentration (MCHC). The results also revealed significant differences (P<0.05) for serum globulin, glucose, cholesterol, urea and creatinine but there was no significant effect (P>0.05) on serum albumin and total protein. The results of carcass characteristics showed significant differences among treatments (P<0.05) for slaughter weight, carcass weight, dressing percentage, skin pelt, tail, feet and abdominal fat. The slaughter weight and carcass weight were better in groups receiving 2.5% grass hopper meal (50% fish meal replacement). From the results, it can be concluded that inclusion of 2.50% grasshopper meal as a replacement for fish meal (50% replacement) has no adverse effects on the haematological parameters, serum biochemistry and carcass characteristics of rabbits.

INTRODUCTION
The use of non-conventional feeds is gaining ground in Nigeria and many other developing countries. Previously, livestock were fed on maize as main source of energy and soybean meal, groundnut cake and fishmeal as main protein sources. This practice has put the livestock industry into direct competition with man for these feed ingredients (Muriu et al., 2002). Consequently, the prices of the conventional feedstuff increased to a level that their inclusion at a required level completely eroded the expected profit of the farmers.

Rabbits can utilize low-grain and high roughage diets (McNitt et al., 1996). Moreover, they breed all year-round, and have a “quick” generation interval. Consequently, they are uniquely poised to provide animal protein for developing countries, where grains can only be justified for human use (Irlbeck, 2001).

Grasshoppers (Zonocerus variegatus) are known to be leaf eating insects and cause maximum destruction of leaves and soft tissues of plants. Grasshopper meal contains about 357.6g/kg DM of crude protein and ether extract of about 158.6g/kg DM (Ojewole et al., 2003). Moreover, it contains about 66.3g/100g dry weight of crude protein, 15.5g/100g dry weight for fat and 12.4g/100g dry weight of crude fibre. This can serve as a good source of protein to rabbits. The potential of
grasshopper meal as a protein source has, however, not
been fully investigated in rabbit nutrition.

The ingestion of numerous dietary components has
measurable effects on blood constituents (Animashahun et al., 2006; Bhatti et al., 2009). Although nutrient levels in
the blood and body fluids may not be valid indication of
nutrient function at cellular level, they are considered to
be proximate measures of long-term nutritional status
(Animashahun et al., 2006). According to Maxwell et al.
(1990), blood parameters are important in assessing the
quality and suitability of feed ingredients in farm animals. Animashahun et al. (2006) affirmed that the comparison
of blood chemistry profile with nutrient intake might
indicate the need for adjustment of certain nutrients
upward or downward for different population groups. The
objective of this study was to investigate the effects of
grasshopper meal on haematological indices, blood
chemistry and carcass characteristics of growing rabbits.

MATERIALS AND METHODS

Experimental animals
Forty weaned rabbits (Dutch x Zealand White), aged 6
to 10 weeks, were randomly assigned to five dietary
treatment groups with eight rabbits per treatment. Each
rabbit was housed in hutches measuring 45 x 30 x 42 cm.
Five experimental diets (Table 1) designed as T1, T2, T3,
T4 and T5 containing 0 (control), 1.25, 2.50, 3.75 and 5%
of grasshopper meal (GHP), respectively were prepared.
These diets were analyzed for dry matter (DM), crude
fibre (CF), crude protein (CP), ether extract (EE), ash,
calcium and phosphorus according to AOAC (2002)
methods. The grasshopper meal replaced fishmeal in
the diets. The experimental diets and clean drinking water
were supplied to the rabbits ad libitum throughout the
experimental period of nine weeks.

Post treatment monitoring
At the end of the experiment, three rabbits per
treatment were randomly selected, weighed, slaughtered
and skinned. After evisceration, the gastrointestinal tracts
(GIT) were removed and the empty carcass weight
recorded. The carcass was cut into parts viz: head, tail
feet, shoulder, rack/ribs, loin and hind-legs. The organ
weights which included liver, lungs, kidneys and fat were
expressed as percentage of slaughter weight. Blood
samples from each of the rabbit in the treatment groups
were obtained using a 5ml plastic syringe through the
marginal ear vein into well labeled sample bottles that
contained ethylene diamine tetra-acetic acid (EDTA) as
anticoagulant. The packed cell volume (PCV), red blood
cell (RBC), white blood cell (WBC) and the haemoglobin
(Hb) concentrations were measured using the Wintrobos
Microhaematocrit, improved Neubauer haemocytometer
and Cyanomethaemoglobin methods respectively (Coles,
1986), while mean corpuscular haemoglobin (MCH)
levels were calculated according to Bush (1991). Similarly,
blood samples collected without anti coagulant were
used for the determination of serum biochemical
constituents viz. albumin, globulin, total protein, glucose,
cholesterol, blood urea and creatinine, using commercially
available analytical kits.

Statistical analysis
All data collected were subjected to analysis of
variance (ANOVA), using completely randomized design.
Significant differences (P<0.05) among treatment means
were determined by the least significant difference (LSD),
as outlined by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Proximate composition
The results of the chemical analysis of diets are
shown in Table 2. The crude protein (CP) in experimental
rations ranged between 24.03 and 24.25%, which is
adequate for growing rabbits, as Omole (1977)
recommended about 18% CP for growing rabbits. The
crude fibre (CF) levels (10.44 to 16.87%) increased with
increase in level of grasshopper meal in the diets. This
may be due to the fact that grasshopper meal contains
about 12.4% CF (Ladeji et al., 2003). The levels (10.44
to 16.87%) were adequate to meet the CF needs of rabbits,
though levels above 17% were reported to depress weight
gain (De Blas et al., 1986). The fat content in grasshopper
meal ranged between 4.36 and 6.89%, which compares
favourably with the 2–5% fat levels recommended for
young rabbits by Irlbeck (2001). The metabolizable
energy (ME) was within the range of 2500 to 2800
Kcal/kg as recommended by Aduku and Olukosi (1990).
The results of the proximate analysis of the grasshopper
meal showed that it contained 64.32% CP, 11.25% CF
and 13.15% EE on the average.

Haematological parameters
The results of the haematological indices are
presented in Table 3. There were significant differences
(P<0.05) among groups for all the haematological
parameters, except for haemoglobin (Hb) and mean
corpuscular haemoglobin concentration (MCHC). The
PCV values (34.00 to 41.00%) were within the range of
30–50% reported by Poole (1987) and 33 to 50% reported
by Hillyer (1994) for growing rabbits. The values
obtained for all the treatment groups indicate nutritional
adequacy of all diets since values did not indicate mal-or-
under nutrition (Church et al., 1984). The RBC count
showed significant differences (P<0.05) among
treatments. The values were within the range of 3.07 to
7.50 x 10^6/mm^3 reported by Fudge (1999) but lower than
5–8 x 10^6/mm^3 reported by Anon (1980). Hackbath et al.
(1983) reported that increased RBC values were
associated with high quality dietary protein and with
disease free animals. These observations were related to
the composition of the diet (Table 1) and the health status
of the rabbits since no rabbit died as a result of any
disease. The white blood cell count (WBC) ranged from
5.30 to 9.10 x 10^5/mm^3, the values were within the range
of 5 to 13 x 10^5/mm^3 reported by Hillyer (1994) for
healthy young rabbits. These results indicate that the
animals were healthy because decrease in number of
WBC below the normal range is an indication of allergic
conditions, anaphylactic shock and certain parasitism,
while elevated values (leucocytosis) indicate the existence
of a recent infection, usually with bacteria (Ahamefule et al.,
2008). The haemoglobin (Hb) concentration compared
favourably with the values of 9.4–17.4 g/dl reported by

Fudge (1999) and Njidda et al. (2006). Animals given T1 had the highest Hb concentration, though it was within the normal range. Hackbath et al. (1983) recorded a strong influence of diet on haematological traits, PCV and Hb being very strong indicators of nutritional status of animals. The MCH, MCV and MCHC values were within range of 50 to 75 um³, 18 to 24 pg and 37 to 34% respectively, as reported by Burke (1994), Fudge (1999) and Gillet (1996). Higher values of MCV (110.74fl) and MCH (38.11pg) observed on T1, however, may not pose a serious problem since PCV, RBC, WBC, Hb and MCHC in all the treatments were within the normal ranges for healthy rabbits (Anon, 1980). Njidda and Hambagda (2006) mentioned PCV, Hb and MCHC as the most dependable blood indices for assessing the health status of animals.

Blood chemistry

The results of the blood chemistry are presented in Table 4. The albumin values showed no significant difference (P>0.05) among treatments and the values fell within the normal range of 2.5 to 4.0 g/dl reported by Anon (1980). The globulin values (1.02 to 2.02 g/dl) showed significant differences (P<0.05) among treatments. The values for T1, T2, T3, T4 and T5 were lower than the values reported by Anon (1980) but similar to 1.94-2.26 g/dl obtained by Onifade and Tewe (1993) who fed various tropical energy feed resources to growing rabbits. The total protein values (4.41 to 5.51 g/dl) were within the range reported by Anon (1980) but lower than 5.81-6.75 g/dl reported by Onifade and Tewe (1993). Since total proteins, albumin and globulin are generally influenced by total protein intake (Birth and Schuldt, 1982; Onifade and Tewe, 1993), the values obtained in this study indicate nutritional adequacy of the dietary proteins. Abnormal serum albumin usually indicates an alteration of normal systemic protein utilization (Apata, 1990). Awosanya et al. (1999) demonstrated the dependence of blood protein on the quality and quantity of dietary protein. The values for blood glucose and cholesterol (Table 4) recorded in this study ranged from 4.80 to 7.6 mmol/l and 2.20 to 4.80 mmol/l respectively. Both glucose and cholesterol levels were significantly different (P<0.05) among treatments, the blood glucose was within the range 4.2-8.9 mmol/l reported by Fudge (1999). Since glucose and cholesterol levels were within the normal range, possibilities of anorexia, diabetes, liver dysfunction and mal-absorption of fat, which are the symptoms of abnormal glucose and cholesterol levels in the blood (Bush, 1991) are ruled out. The blood urea values were within the range of 2.50 to 5.80 mmol/l reported by Njidda and Hambagda (2006), who fed sesame seed meal to growing rabbits in tropical environment. Decreased blood urea may be associated with severe liver disease or protein malnutrition (Bush, 1991). There was no sign of ill-health observed in the rabbits and from the result of the feed analysis all the diets met the minimum levels required in the diets of growing rabbits. Serum creatinine levels were within normal range and did not differ (P>0.05) among treatment groups. The values obtained for animals on diets T1, T2 and T3 were in consonance with the findings of Ahamefule et al. (2009), who fed cassava peels processed using different methods. The results also suggest that there was no wasting or catabolism of muscle tissues, and that animals were not surviving at the expense of body reserve. This was a good indication that dietary protein was well utilized by rabbits.

Carass characteristics

The results of the carcass characteristics are shown in Table 5. The slaughter weight and carcass weight were highest in rabbits fed diet T3 containing 2.5% grasshopper meal (50% fish meal replacement). There were significant differences (P<0.05) among treatments for skin pelt, tail and feet, with T2 having the highest value for skin pelt and tail. The dressing percentage ranged from 45.75 to 70.03% with the highest in T2 (70.03%) and lowest in T5 (45.75%). The higher dressing percentage may be related to the higher fat content recorded with the carcass. This is similar to the report of Fielding (1991), who opined that the dressing percentage of rabbits normally ranges from 50 to 56% and tends to be greater if the rabbits are fully grown and have some fat. This was also observed in the present study where T2 having the highest dressing percentage (70.03%) also had higher abdominal fat (Table 6, 0.77%), while T3 having the lowest (45.75%) dressing percentage also had the lowest abdominal fat (0.32%). Fielding (1991) further stated that the dressing percentage would be 50% or less if the rabbit is young, thin and with a full digestive tract at killing. Uko et al. (2001) obtained dressing percentage ranging from 67.60 to 68.40% in rabbits in which the fur was removed by roasting and the head left intact. The study revealed that there was a relationship between dressing percentage and abdominal fat of carcass.

Values obtained for heart, lungs kidneys and liver weights (Table 6) in this study showed non significant differences (P>0.05) among treatment groups. It is a common practice in feeding trials to use weights of some internal organs like liver and kidneys as indicators of toxicity. Bone (1979) reported that if there is any toxic element in the feed, abnormalities in weights of liver and kidney would be observed. The abnormalities arise because of increased metabolic rate of the organ in attempt to reduce these toxic elements or anti-nutritional factors to non-toxic metabolites. Our observations regarding liver and kidney weights in rabbits of different treatment groups suggest that the test diets did not contain any appreciable toxin. Values obtained by Ekpo et al. (2009) did not show any significant difference (P>0.05) among treatments for heart, lungs, kidney and liver of rabbits fed cassava tubers meals.

Conclusion

From these result, it can be concluded that growing rabbits could tolerate up to 2.5% grasshopper meal (50% replacement of fish meal) in their diets without adverse effects on their blood and carcass characteristics.
Table 1: Composition of experimental diets

<table>
<thead>
<tr>
<th>Ingredients (%)</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
</tr>
</thead>
<tbody>
<tr>
<td>White maize</td>
<td>37.35</td>
<td>37.35</td>
<td>37.35</td>
<td>37.35</td>
<td>37.35</td>
</tr>
<tr>
<td>Groundnut cake</td>
<td>17.00</td>
<td>17.00</td>
<td>17.00</td>
<td>17.00</td>
<td>17.00</td>
</tr>
<tr>
<td>Groundnut haulm</td>
<td>15.00</td>
<td>15.00</td>
<td>15.00</td>
<td>15.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Maize bran</td>
<td>23.00</td>
<td>23.00</td>
<td>23.00</td>
<td>23.00</td>
<td>23.00</td>
</tr>
<tr>
<td>Fish meal</td>
<td>5.00</td>
<td>3.75</td>
<td>2.50</td>
<td>1.25</td>
<td>0.00</td>
</tr>
<tr>
<td>Grasshopper meal</td>
<td>0.00</td>
<td>1.25</td>
<td>2.50</td>
<td>3.75</td>
<td>5.00</td>
</tr>
<tr>
<td>Bone meal</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Salt</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Premix</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Table 2: Proximate composition of experimental diets and grasshopper meal (GHM)

<table>
<thead>
<tr>
<th>Nutrients (%)</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>GHM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter (DM)</td>
<td>97.53</td>
<td>97.28</td>
<td>97.03</td>
<td>96.78</td>
<td>96.53</td>
<td>94.45</td>
</tr>
<tr>
<td>Crude protein (CP)</td>
<td>24.03</td>
<td>24.11</td>
<td>24.18</td>
<td>24.25</td>
<td>24.03</td>
<td>64.32</td>
</tr>
<tr>
<td>Crude fibre (CF)</td>
<td>10.44</td>
<td>12.50</td>
<td>16.73</td>
<td>16.87</td>
<td>16.01</td>
<td>11.25</td>
</tr>
<tr>
<td>Ether extract (EE)</td>
<td>4.36</td>
<td>5.99</td>
<td>5.62</td>
<td>5.25</td>
<td>6.89</td>
<td>13.15</td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>1.13</td>
<td>1.16</td>
<td>1.19</td>
<td>1.20</td>
<td>1.23</td>
<td>1.50</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>0.64</td>
<td>0.70</td>
<td>0.77</td>
<td>0.83</td>
<td>0.89</td>
<td>0.89</td>
</tr>
<tr>
<td>Ash</td>
<td>2.19</td>
<td>2.31</td>
<td>2.50</td>
<td>2.70</td>
<td>2.90</td>
<td>0.63</td>
</tr>
<tr>
<td>ME (Kcal/kg)*</td>
<td>2851.80</td>
<td>2851.87</td>
<td>2851.95</td>
<td>2851.10</td>
<td>2852.80</td>
<td>4.23</td>
</tr>
</tbody>
</table>

*ME = Metabolizable energy

Table 3: Effect of feeding grasshopper meal substituting fish meal on haematological indices of weaned rabbits

<table>
<thead>
<tr>
<th>Parameters</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV (%)</td>
<td>34.00b</td>
<td>35.00b</td>
<td>36.00b</td>
<td>41.00a</td>
<td>36.00b</td>
<td>2.02*</td>
</tr>
<tr>
<td>RBC (X10^6/mm^3)</td>
<td>3.07b</td>
<td>7.50a</td>
<td>6.80a</td>
<td>7.30a</td>
<td>1.10a</td>
<td>2.68*</td>
</tr>
<tr>
<td>WBC (x 10^3/mm^3)</td>
<td>9.10a</td>
<td>5.30c</td>
<td>5.40c</td>
<td>6.90b</td>
<td>7.50a</td>
<td>1.39*</td>
</tr>
<tr>
<td>Hb (g/dl)</td>
<td>11.70</td>
<td>11.70</td>
<td>9.70</td>
<td>13.70</td>
<td>9.70</td>
<td>2.36NS</td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>110.74a</td>
<td>56.69c</td>
<td>51.47b</td>
<td>56.16b</td>
<td>50.70c</td>
<td>0.32*</td>
</tr>
<tr>
<td>MCH (Pg)</td>
<td>38.11a</td>
<td>19.6c</td>
<td>18.26b</td>
<td>18.76b</td>
<td>18.67c</td>
<td>0.07*</td>
</tr>
<tr>
<td>MCHC (%)</td>
<td>34.41</td>
<td>33.43</td>
<td>33.44</td>
<td>33.41</td>
<td>33.49</td>
<td>7.03NS</td>
</tr>
</tbody>
</table>

Means within the same row with different superscripts differ significant at (P<0.05); NS = Non significant (P>0.05); * = significant (P<0.05).

Table 4: Effect of feeding grasshopper meal substituting fish meal on serum metabolite of weaned rabbits

<table>
<thead>
<tr>
<th>Parameters</th>
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<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumin (g/dl)</td>
<td>2.81</td>
<td>3.01</td>
<td>3.51</td>
<td>2.41</td>
<td>3.91</td>
<td>0.94NS</td>
</tr>
<tr>
<td>Globulin (g/dl)</td>
<td>1.71a</td>
<td>1.41b</td>
<td>2.02a</td>
<td>1.62a</td>
<td>1.02c</td>
<td>0.02*</td>
</tr>
<tr>
<td>Total protein (g/dl)</td>
<td>4.51</td>
<td>4.41</td>
<td>5.51</td>
<td>5.01</td>
<td>4.91</td>
<td>1.19NS</td>
</tr>
<tr>
<td>Glucose (mmol/L)</td>
<td>6.50a</td>
<td>4.80b</td>
<td>6.40a</td>
<td>7.60a</td>
<td>6.10a</td>
<td>1.32*</td>
</tr>
<tr>
<td>Cholesterol (mmol/L)</td>
<td>2.80a</td>
<td>4.00b</td>
<td>2.20d</td>
<td>3.50c</td>
<td>4.80a</td>
<td>0.22*</td>
</tr>
<tr>
<td>Blood urea (mmol/L)</td>
<td>3.10a</td>
<td>2.90b</td>
<td>2.60b</td>
<td>3.00a</td>
<td>4.90a</td>
<td>0.71*</td>
</tr>
<tr>
<td>Creatinine (µmol/L)</td>
<td>63.10a</td>
<td>67.11a</td>
<td>54.11b</td>
<td>52.10b</td>
<td>66.10a</td>
<td>4.65*</td>
</tr>
</tbody>
</table>

Mean within the same row with different superscripts significantly different (P<0.05); NS = Non significant (P>0.05); * = significant (P<0.05); SEM = Standard Error of Means
Table 5: Effect of feeding grasshopper meal substituting fish meal on carcass characteristics of weaned rabbits

<table>
<thead>
<tr>
<th>Parameters</th>
<th>T1</th>
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<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers of Rabbits</td>
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<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Slaughter weight (g)</td>
<td>1250.00&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1166.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1483.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1450.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1020.00&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.27*</td>
</tr>
<tr>
<td>Carcass weight (g)</td>
<td>700.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>816.66&lt;sup&gt;d&lt;/sup&gt;</td>
<td>866.66&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>800.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>466.66&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.15*</td>
</tr>
<tr>
<td>Percentage (%)</td>
<td>56.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>70.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>58.43&lt;sup&gt;b&lt;/sup&gt;</td>
<td>55.17&lt;sup&gt;b&lt;/sup&gt;</td>
<td>45.75&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.21*</td>
</tr>
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</table>

Body component expressed as percent slaughter weight

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>9.10</td>
<td>11.32</td>
<td>8.81</td>
<td>8.03</td>
<td>10.97</td>
<td>3.06&lt;sup&gt;NS&lt;/sup&gt;</td>
</tr>
<tr>
<td>Skin pelt</td>
<td>10.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12.29&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.59&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.02&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8.31&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.28*</td>
</tr>
<tr>
<td>Tail</td>
<td>0.61&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.76&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.25&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.27&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.22&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.08*</td>
</tr>
<tr>
<td>Feet</td>
<td>0.72&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.68&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.28&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.89&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.28*</td>
</tr>
<tr>
<td>Shoulders/forelegs</td>
<td>9.95</td>
<td>9.45</td>
<td>7.37</td>
<td>8.75</td>
<td>7.98</td>
<td>0.22&lt;sup&gt;NS&lt;/sup&gt;</td>
</tr>
<tr>
<td>Racks/ribs</td>
<td>9.95</td>
<td>9.83</td>
<td>8.25</td>
<td>8.43</td>
<td>11.97</td>
<td>0.09&lt;sup&gt;NS&lt;/sup&gt;</td>
</tr>
<tr>
<td>Loin</td>
<td>14.02</td>
<td>15.20</td>
<td>15.16</td>
<td>15.34</td>
<td>14.25</td>
<td>3.25&lt;sup&gt;NS&lt;/sup&gt;</td>
</tr>
<tr>
<td>Hind legs</td>
<td>17.81</td>
<td>19.14</td>
<td>18.59</td>
<td>17.11</td>
<td>18.62</td>
<td>3.17&lt;sup&gt;NS&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Mean within the same row with different superscripts significantly different (P<0.05); NS = Non significant (P>0.05); * = significant; SEM = Standard Error of Means

Table 6: Effect of feeding grasshopper meal substituting fish meal on organ weight of weaned rabbits

<table>
<thead>
<tr>
<th>Parameters</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>SEM</th>
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</thead>
<tbody>
<tr>
<td>Number of rabbits</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Slaughter weight (g)</td>
<td>1250.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1166.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1483.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1450.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1020.00&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.27*</td>
</tr>
<tr>
<td>Carcass weight (g)</td>
<td>700.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>816.66&lt;sup&gt;d&lt;/sup&gt;</td>
<td>866.66&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>800.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>466.66&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.15*</td>
</tr>
<tr>
<td>Heart</td>
<td>0.35</td>
<td>0.38</td>
<td>0.22</td>
<td>0.28</td>
<td>0.27</td>
<td>2.00&lt;sup&gt;NS&lt;/sup&gt;</td>
</tr>
<tr>
<td>Liver</td>
<td>3.11</td>
<td>3.61</td>
<td>3.01</td>
<td>3.27</td>
<td>3.52</td>
<td>1.37&lt;sup&gt;NS&lt;/sup&gt;</td>
</tr>
<tr>
<td>Lungs</td>
<td>0.63</td>
<td>0.66</td>
<td>0.63</td>
<td>0.76</td>
<td>0.67</td>
<td>0.07&lt;sup&gt;NS&lt;/sup&gt;</td>
</tr>
<tr>
<td>Kidney</td>
<td>0.86</td>
<td>0.85</td>
<td>0.76</td>
<td>0.57</td>
<td>0.67</td>
<td>0.14&lt;sup&gt;NS&lt;/sup&gt;</td>
</tr>
<tr>
<td>Abdominal fat</td>
<td>0.52&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.77&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.38&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.39&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.34&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.19*</td>
</tr>
</tbody>
</table>

Mean within the same row with different superscripts significantly different (P<0.05); NS = Non significant (P>0.05); *= significant; SEM = Standard Error of Means

REFERENCES


