GROWTH PERFORMANCE OF GROWING RABBITS AS AFFECTED BY DIETS CONTAINING DIFFERENT LEVELS OF GUAVA BY-PRODUCT (Psidium guajava)

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ABSTRACT
A total thirty six New Zealand White (NZW) male rabbits, 5 weeks of age were used in this study to investigate the effect of a partial replacement of berseem hay and barley in commercial basal diet with Guava by-product (Psidium guajava), as untraditional feedstuff, at three levels (5, 10 and 15%) on growth performance, digestibility coefficients of nutrients, some carcass traits and economic efficiency.

The rabbits were randomly divided into 4 experimental groups (9 rabbits each). The 1st group was fed a pelleted basal diet, while the 2nd, 3rd and 4th groups were fed a diets containing 5, 10 and 15% Guava by-product, respectively. The experimental period was extended for 6 weeks.

Obtained results indicated that growth performance parameters had no adverse effect when experimental diets included up to 10% Guava by-product, while the main significant improvement in final body weight, total body weight gain, average daily gain and performance index were achieved for rabbit fed diets containing at level 5% Guava by-product.

On the other hand, daily feed intake, feed conversion, protein efficiency ratio (PER), carcass traits or caecum parameters had not significantly affected. However, the rabbits which fed diets containing 15% Guava by-product were recorded depression in these criteria.

Digestibility coefficients of DM, CF, EE, NFE and the nutritive values of the experimental diets were not affected by inclusion of Guava by-product in the diets, while the digestibility coefficients of OM or CP had significant depression when the diets included 10 or 15% Guava by-product.

In point the economical values, the highest economical efficiency (%) was recorded for rabbit group fed a diet contained 5% Guava by-product.

Key words: Rabbits, Guava by-product, performance, digestibility, carcass traits, economic efficiency.

INTRODUCTION
Rabbits are herbivorous animals consuming high roughage diets based on grass, lucerne, alfalfa and many other forage crops (El-Hindawy et al., 2003). Since, the principle factor affecting the annual profit margin is the cost of feeding, it is
necessary to seek for non-traditional and cheaper feedstuffs to decrease the feeding cost.

Additional shortage of feedstuffs is one of the major limiting factors for increasing animal and poultry production.

Incorporation of cheap untraditional feedstuffs such as the agro–industrial by-products in the animal diets substantially participates in solving the problem and decreases the cost of feed, which in turn decreases the marketing price of rabbit production, (Shqueir and Qwasmi, 1994).

As a herbivorous and semi-ruminant animals the nutrient requirements for rabbits are still questionable and under investigation (Cheeke, 1987). There was no available literature on using Guava by-product in rabbit feeding Abd-Alla (1993) recorded a good intake for broiler fed Guava by-product (during the finisher period), without any harmful effect on health of performance parameters.

In Egypt, 243434 ton/year of Guava fruit are produced (Egyptian Ministry of Agriculture, 2005). Guava by-product (GBP) is the residue of juice extraction of the fruit and estimated to be 30% of the original quantity.

Therefore, the aim of this study is to investigate the possibility of incorporating different levels of Guava by-product in growing rabbit diets, and their effects on growth performance, nutrients digestibility and nutritive values, carcass traits and economic efficiency under Egyptian conditions.

MATERIALS AND METHODS

The present study was conducted at a Private Rabbitry farm (Daltex Company, El-Mollack Valley) Sharkeia Governorate, during September and October 2005. The experiment work was extended for 6 weeks.

A total number of 36 male New Zealand White (NZW) rabbits of 5 weeks old with an average body weight nearly similar (639.98 ± 15.73) were divided into four experimental groups. Guava by-product was collected from Kaha Company and dried at 70°C for 24 hours, then ground well mixed (the price of one ton 200 LE).

The first group was fed a pelleted basal diet (without Guava by-product) while second, third and fourth groups were fed pelleted diets contained 5, 10 and 15% of Guava by-product, respectively, in replacement berseem hay and Barley (from 5 up to 11 weeks of age).

Feed ingredients and chemical composition of the experimental diets are presented in Table (1). Guava by-product, berseem hay and barley were analyzed according to A.O.A.C. (1990).

The rabbits were housed (each of 3 together) in wire cages (60 x 55x 40 cm) provided with galvanized feeders and nipple drinkers. Feed and fresh water were daily offered to rabbits *ad libitum*. Individual live body weight, daily body weight gain, feed intake and feed conversion rate were weekly recorded. All the rabbits were kept under the same managerial, hygienic and environmental conditions.

The following parameters such as weight gain, feed intake, feed conversion (g feed / g gain) and protein efficiency ratio (PER) were calculated during the
Table 1: Ingredients and chemical analysis of the experimental diets

<table>
<thead>
<tr>
<th>Items</th>
<th>Control</th>
<th>5%</th>
<th>10%</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guava by-product</td>
<td>00.00</td>
<td>05.00</td>
<td>10.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Berseem hay</td>
<td>20.00</td>
<td>16.00</td>
<td>12.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Barley</td>
<td>30.00</td>
<td>30.00</td>
<td>26.00</td>
<td>24.00</td>
</tr>
<tr>
<td>Yellow corn</td>
<td>5.30</td>
<td>5.30</td>
<td>5.30</td>
<td>5.30</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>22.00</td>
<td>21.00</td>
<td>24.00</td>
<td>23.00</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>16.00</td>
<td>16.00</td>
<td>16.00</td>
<td>16.00</td>
</tr>
<tr>
<td>Molass</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Limestone</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Salt</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td>Vitamins + Minerals*</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>D., L. Methionine</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Chemical analysis (% on air dry basis):

- Dry mater %
- Organic matter %
- Crude protein %
- Digestible energy (Kcal/Kg)**
- Ether extract %
- Crude fiber %
- Nitrogen free extract %
- Ash %
- Calcium (Ca) %**
- Phosphorus (P) %**
- Lysin **
- Methionine + cyst **

*Each kilogram contains: Vit. A 2000000 IU, Vit. D3 150000 IU, Vit. E 83.33 g, Vit. K0.33 g, Vit. B1 0.33 g, Vit. B2 1.0 g, Vit. B6 0.33g, Vit. B12 1.7 mg, Pantothenic acid 3.33g, Niacin 8.33 g, Biotin 33 mg, Folic acid 0.83 g, Choline chloride 200 g, Zn 11.79 g, Fe 12.5 g, Cu 0.5g, Co 1.33 mg, Se 16.6 mg, Mg 66.79 mg and Mn 5.0 g.

**Calculated according to NRC (1977).

Experimental period (5 to 11 weeks of age). Economic efficiency was calculated as follows equation:

Economic efficiency (EE) = (A - B) / B × 100

Where: A = Price of Kg gain in Egyptian pound (L.E.), B = Feed cost per Kg gain (L.E.).

Performance Index (PI) was calculated according to North (1981) as follows equation: Performance Index = live weight (Kg) / Feed conversion × 100.
Slaughter trial:

At 11 weeks of age, three rabbits from each group were slaughtered and carcass traits were recorded by the standard technique according to Ckeeke et al. (1982).

At the end of the experimental periods (11 week of age), four digestibility trials were conducted by using three male rabbits from each treatment group which were housed individually in metabolic cages.

The experimental period was considered as a preliminary period followed by 6 successive days collection period according to the European reference method for rabbit digestion trails (Perez et al., 1995).

The composite samples of Guava by-product, diets offered and faeces output were chemically analyzed according to A. O. A. C. (1990) for crude protein, crude fiber, ether extract, nitrogen-free extract and total ash.

DE (kcal/kg diet) values of the experimental diets were calculated according to the equation described by Schiemann et al. (1972) as follows:

\[ DE \ (\text{kcal/kg diet}) = 5.28 \ (DCP \ g/kg) + 9.51 \ (DEE \ g/kg) + 4.2 \ (DCF + DNFE \ g/kg) + 0.3. \]

The total digestible nutrients (RDN) values of the diets were calculated by multiplying the digestible ether extract (EE) by factor 2.25 and multiplying each of digestible crude protein (CP), crude fiber (CF) and nitrogen free extract (NFE) by the factor 1.0.

Data of the experiment for all the variable were subjected to statistical analysis according to Snedecor and Cochran (1982) by using SPSS system (1998). The difference between means were tested using Duncan’s New Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition of (GBP):

A detailed chemical analysis of (GBP) used in the present study is shown in Table 2. The chemical composition of Guava by-product was nearly similar to the values given by Abd-Alla (1993), who found that raw guava by-product (RGP) contained 9.08% CP, 10% EE, 39.5% CF, 32.97% NFE, 2.55% CA, 0.38% calcium and 0.10% total phosphorus.

However, data indicated that GBP has adequate nutrients that could be used in rabbit diets when compared to berseem hay and barley. Feed ingredient and chemical analysis of the experimental diets according to NRC (1977) are presented in Table 1.

Growth performance and feed utilization:

Results in Table 3 show that final body weight at the end of the experiment were 1591.87, 1679.64, 1577.93 and 1535.41 g for rabbits fed diets contained 0, 5, 10 and 15% GBP, respectively. The level of 5% GBP in the diet resulted the heavier significant live body weight, while, 15% GBP in the diet had the lowest significant live body weight.
Total weight gain and average daily body gain took the same trend of line body weight and the best significant gain was achieved when the diets included 5% GBP compared with control or other diets. The same trend had been reported by Ghazalah and El-Shahat (1994) they found a significant increase in live body weight and weight gain of rabbits fed olive kernel meal (OKM) replaced 50% of barley, while it reduced significantly when (OKM) were replaced 75 and 100% of barley. Abd El-Galil (2001) found also, that body weight gain of growing rabbits decreased by increasing olive pulp meal level more than 10% during (5-9 weeks of age) and 15% during (9-13 weeks of age).

On the other hand, data showed that no significant differences in daily feed intake, feed conversion and PER when rabbits were feed diets included from 5% up to 15% GBP compared with control diet. However, insignificant improvements in these criteria were observed when experimental diet contained 5% GBP. These results agree with those obtained by Mousa and Abdel-Samee (2002) who did not find significant difference in feed intake of growing rabbits feed diets containing (0.0, 10 and 20% olive pulp). Also, El-Kerdawy (1997) in earlier studies found that, daily feed consumption for rabbits fed diets containing 0.0, 5.0, 10.0 and 15.0% olive pulp did not differ significantly.

**Nutrients digestibility and nutritive values:**

The results in Table 4 showed that, digestibility coefficients of OM and CP for growing rabbits fed control diet or including 5% GBP were significantly (P<0.5) better than obtained by rabbits fed diets contained 10 or 15% GBP. Abd-Alla (1993) suggested that Guava waste incorporate pectin, which, reduce protein utilization. However, the digestion coefficient values of DM, CF, EE and NFE did not differ among treatment groups. The same results reported by Hatem (2003) where, concluded that apparent digestibility of CP and CF for rabbits fed diets contained 5%-10% olive cake did not reduce as compared to control, while, those contained 15% or 20% olive cake were significantly decreased (P<0.05). However, digestibility of DM, OM, EE and NFE were insignificantly affected by aforementioned levels of olive cake.

From the data in Table 4, it could be noticed that, the digestibility of nutritive values as DCP, TDN and DE were significantly decreased with increasing GBP level up to 15% in the experimental diets.

These results agree with those obtained by Ismail and Gippert (1999) using different levels of sunflower–cake diets of growing NZW rabbits.

**Slaughter traits:**

Data of slaughter test of rabbits fed diet contained different levels of GBP in Table (5), did not show any significant differences for dressing weight, carcass weight, giblets weight percentages or caecum parameters [Length- circum ference- full weight (g)]. These results agree with those reported by El-Kerdawy (1997) and Zaza et al. (2001). They reported no significant differences in carcass traits for rabbits consumed diet including 5, 10, 15% and 20% olive cake.
Similar results were obtained by Soad et al. (1994) who found that, no differences in the percentages of each of carcass, giblets and alimentary tract weights when rabbit diets contained 0.0, 10., 20 and 30% tomato pomace.

Moreover, El-Manylawi (2005) concluded that, rabbit groups fed on diets contained 3, 6 or 9% of geranium or spearmint by-product did not differ significantly as compared to control group in empty carcass, giblets and dressing percentages.

**Economic evaluation:**
From the economical point, costs of feed / kg gain were 3.65, 3.68 and 3.76 L.E. for rabbits fed the diets which contained 15%, 5% and 10% GBP, respectively (Table 6). While, that fed control diet was recorded the highest feed cost (4.03 L.E). Performance index (PI) for the experimental rabbits group fed diet contained 5% GBP at level 5% had achieved the best significant value, while, that contained GBP at level 15% recorded the lowest significant value. Also, the best relative economical efficiency (129.58%) was achieved by diet contained 5% GBP as compared with control diet (100%), under Egyptian conditions.

**Conclusion:**
Results of this study concluded that guava by-product (*Psidium guajava*) could be included up to 5% in diets of growing NZW rabbits in place of berseem hay and barley without any adverse effects on their growth performance and nutrients utilization, under Egyptian conditions.

**REFERENCES**


استخدم في هذه الدراسة 36 ذكر أربعة نامي من نويع البذور الابيض mesure (6) أسابيع في تجربة
( أستمرت الفترة 6 أسابيع ) بعد تأثير الاستبدال الجزيئي لكل من دراسة البريسي وشعير في عالق
الأرانب النامية بقل الجواقة كمصادر غير تقليدية في تغذية الأرانب على معدل الأداء ومعاملات الهضم
وبعض صفات الذبيحة والكفاءة الاقتصادية

1- نسبة暴跌ت عشوائياً إلى [ ] مجموعات التجريبية ممتلاة تقريباً بمتوسط وزن 128.98 جم ( تحتوي
كل مجموعة على 3 مكررات ) حيث استخدم [ ] مستويات إخلال من مختلف قلل الجواقة هي [ صفر
الأيزوي ] [ 0.5 - 10 % ] من دراسة البريسي وشعير وكانت جميع العالق التجريبية ممتلاة تقريباً في قيمتها
الغذائية [ 0.5 - 15.85 % بروتين خام، 0.43 - 15.65 % بروتين خام، 0.67 - 27.6 % 
ك كلور في طاقة مهيئية / كجم ].

أوضحت النتائج ما يلي:

1) احتواء عالق الأرانب على قلل الجواقة بنسبة تصل إلى 10 % لم يؤثر سلباً على معدلات أداء الأرانب

2) أفضل تحسين معنوي في ( وزن الجسم، الزيادة في النمو، متوسط النمو اليومي، لديل الأداء ) تم
الحصول عليه عند مستويات إضافية 5 % تقل جواقة. وفي المقابل سجلت نفس هذه القياسات انخفاضاً
معنوياً عندما وصلت نسبة الإضافية إلى 15 % تقل جواقة بينما لم تلاحظ أي فروق معنوية نتيجة
المعاملات في كل من كمية الغذاء المستهلك أو معدل التحويل الغذائي أو معدل الاستهلاك من بروتين الغذاء.

3) معاملات الهضم لكل من المادة الجافة والألياف الخام والدهن الخام والمستخلص الخالي من النتروجين لم
تأثر معنويًا بإضافة تقل الجواقة للعالق. بينما انخفضت معدل الهضم معنويًا لكل من المادة العضوية
والبروتينات الخام عند إضافات تقل الجواقة بمستويات 10 أو 15 %، على أي حال لم تتأثر القيم
الغذائية لكل من البروتينات المهيوم والمركبات المهيوم الكلية والطاقة المهيوم بحسب احتواء العالق على
تقل جواقة.

4) لم تسجل أي اختلافات معنوية بقياس النووي والاغذية نتيجة استخدام العالق التجريبية مقارنة بعلاقة
الكنتمول

5) تحسين العائد الاقتصادي نتيجة إضافات 5 أو 10 % تقل جواقة للعالق التجريبية بينما كانت أفضل
كفاءة اقتصادية سجلت للمجموعة التي غذت عليها احتوت 5 % تقل جواقة.