INFLUENCE OF DIETARY SUPPLEMENTATION OF SACCHAROMYCES CEREVICIAE AND CANDIDA RUGOSA ON PRODUCTION ECONOMICS AND SENSORY EVALUATION OF COOKED RABBIT MEAT RAISED UNDER CAGE AND PEN SYSTEM OF HOUSING

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ABSTRACT

Thirty two weaned New Zealand White rabbits of either sex were randomly divided into four treatment groups. Experimental rabbits in treatment groups T₁ and T₂ were housed in cage system while rabbits under treatment groups T₃ and T₄ were housed in pen system. Rabbits of treatment groups T₁ and T₃ were fed standard concentrate diets without yeast supplementation while T₂ and T₄ were fed concentrate diets supplemented with 2% yeast (Saccharomyces cereviciae and Candida rugosa, 2 X 10¹³ cfu). At 13 weeks of age, rabbits raised in cage housing system (T₁ & T₂) had significantly (P< 0.05) lower cost of feeding(Rs./kg body weight gain (75.73, 75.38 vs. 75.92, 77.82) than the rabbits raised in pen system (T₃ & T₄). The DMI/day and FCR did not differ significantly for different dietary and housing treatments. Rabbits fed 2% yeast supplementation (T₂) in cage system had higher (P< 0.05) tenderness scores (7.70 vs. 7.35, 7.20, 6.70) and juiciness scores (7.72 vs. 7.30, 7.23, 6.70) than T₁, T₃ and T₄. The results of the study inferred that rabbits reared in cage system and supplemented with 2% yeast in their standard diet is most profitable rearing method with most efficient feed economics and sensory attributes of cooked rabbit meat.

Key words: Cage, Pen, Rabbit meat, Sensory evaluation, Yeast.

INTRODUCTION

Nowadays scientists, leaders of food industry and even consumers need information on the effect of different housing system not only on the animal welfare and health but also on sensory traits and economics of production. In order to meet the prospect of customers, several researchers have studied the effects of alternative housing systems and yeast supplementation on the performance traits of fattening rabbits. According to Metzger et al. (2003a, 2003b); Onifade et al. (1999) and Paryad et al. (2008), the housing system and yeast supplementation affects body weight and sometimes the meat quality (Dal Bosco et al. 2000, 2002).

Keeping this in mind, experiment was carried out to study the influence of alternate housing systems (pen and cage housing systems) and yeast supplementation (Saccharomyces cereviciae and Candida rugosa) on feed economics and sensory evaluation of edible rabbit meat.

MATERIALS AND METHODS

Thirty two New Zealand White rabbits of either sex of 6 weeks of age having average body weights of 618.59±10.09 g were procured from Disease Free Small Animal House, LUVAS, Hisar after due approval from the Institutional Animal Ethics Committee. Rabbits were randomly assigned to four treatments in four tier cages (0.45 X 0.45 m, 0.40 m high, 1 rabbit/cage, 4.94 rabbits/ m², n= 16) or in pen with wire mesh floor (1.50 X 2.00 m, 1.00 m high, 4 rabbits/pen, 1.33 rabbits/ m², n= 16) in a closed room where the temperature was maintained 20±5°C and humidity 60+15% during the trial. The experiment consisted of two housing and dietary treatments, each. The rabbits in treatment groups T₁ and T₃ were housed in cage system while those in T₂ and T₄ were housed in pen system. The rabbits of groups T₁ and T₃ were fed control concentrate mixture as per ICAR (2008) recommendations while

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in treatment T\textsubscript{2} and T\textsubscript{4} the rabbits were fed control concentrate mixture supplemented with 2% yeast (Saccharomyces cerevisiae and Candida rugosa; 10^{13} billion colony forming units/kg) at a rate of 20g/kg concentrate feed. The concentrate mixture was prepared by mixing half crushed ingredients and contained maize, deoiled rice polish, soybean meal, groundnut cake, gram, mineral mixture and iodized salt (Table 1). In addition to concentrate feed, locally available berseem (Trifolium alexandrinum) fodder was also fed ad libitum. The concentrate mixture and roughage were analyzed for proximate composition, (AOAC, 2005).

The kits were offered concentrate in the morning at 9:00 a.m and roughage in the afternoon at 3:00 p.m and residual feed was weighed and discarded before offering fresh feed. The kits were given daily clean drinking water in the containers hanging tightly in the cages. Ad libitum feed was supplied throughout the experiment. The feed containers were hanged tightly at neck level of rabbits to avoid any spilling and wastage of feed. The study was carried out for a period of 45 days on selected rabbits. The rabbits were dewormed with ivermectin at the dose rate of 200 microgram/kg subcutaneously and also treated prophylactically against coccidiosis with coccidiostat according to manufacturer’s prescription.

Relative cost of production was also calculated at the end of study. The cost of production included the cost of feed consumed among the treatments to know which dietary supplementation was more profitable.

All the rabbits were weighed at the beginning and at the end of the experimental trial, of which 16 rabbits (4 per treatment) were randomly slaughtered for meat quality analysis. Selected animals were numbered for slaughter and were transferred in small groups to the slaughter facility at the Livestock Products Technology department of the university. Slaughtering of rabbits and carcass dissection was done as per the recommendations of Blasco et al. (1992).

About 100 g of deboned rabbit meat in the form of chunks was weighed and the sample was taken in 250 ml beaker after adding 1.5 % salt to it. The beaker was then placed inside an autoclave and meat chunks were allowed to cook for 15 minutes at 15 lbs pressure. This deboned cooked meat was subjected to organoleptic evaluation using 9 point

<table>
<thead>
<tr>
<th>Table 1: Ingredient and chemical composition of concentrate mixture and berseem fed to rabbits under different treatment groups.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ingredient (g/kg)</strong></td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>Maize</td>
</tr>
<tr>
<td>Deoiled rice polish</td>
</tr>
<tr>
<td>Soybean meal</td>
</tr>
<tr>
<td>Groundnut cake</td>
</tr>
<tr>
<td>Gram</td>
</tr>
<tr>
<td>Nutriyeast*</td>
</tr>
<tr>
<td>Iodized salt</td>
</tr>
<tr>
<td>Mineral mixture*</td>
</tr>
<tr>
<td>Spectromix Powder premix†</td>
</tr>
<tr>
<td>Spectro BE: Powder premix‡</td>
</tr>
<tr>
<td><strong>Chemical composition (% DM basis)</strong></td>
</tr>
<tr>
<td>Dry matter</td>
</tr>
<tr>
<td>Crude protein</td>
</tr>
<tr>
<td>Ether extract</td>
</tr>
<tr>
<td>Crude fibre</td>
</tr>
<tr>
<td>Nitrogen free extract</td>
</tr>
<tr>
<td>Ash</td>
</tr>
</tbody>
</table>

* Nutriyeast containing 10^{13} billion cfu/kg of Saccharomyces cerevisiae and Candida rugosa

* Mineral mixture (saltfree)-Ca (32%), Cu (100 ppm), Zn (0.26%), I (0.01%), P (6%), Mn (0.27%), Fe (1000 ppm) and Co (50 ppm).


RESULTS AND DISCUSSION

The mean values of total dry matter intake in $T_1$, $T_2$, $T_3$ and $T_4$ were 4759.24, 4787.67, 4521.34 and 4670.72 g, respectively (Table 2). The results of the study indicated that mean values of total dry matter intake in cage system of housing with or without yeast supplementation tended to be higher as compared to pen system with or without yeas supplementation though no statistical significance was found as per Duncan analysis. From the results, it was found that yeast supplementation also marginally increases the total dry matter intake slightly.

Similarly, the mean values of dry matter intake/ day in $T_1$, $T_2$, $T_3$ and $T_4$ were 105.76, 106.39, 100.47 and 103.79 g/day, respectively (Table 2). The results of the study indicates that mean values of dry matter intake/ day in cage system of housing tends to be higher as compared to pen system though no statistical significance was found as per Duncan analysis. From the results, it was also found that yeast supplementation also increases the total dry matter intake slightly (Table 2). Higher dry matter intake/ day of rabbits in $T_1$ and $T_3$ was primarily due to lesser space and more visual contact of rabbits with feed. The mean values of feed conversion ratio in $T_1$, $T_2$, $T_3$ and $T_4$ were 5.06, 4.92, 4.93 and 4.89, respectively (Table 2). The results of the study indicates that mean values of FCR of rabbits fed with yeast supplementation was higher than rabbits not given yeast supplementation, irrespective of cage or pen housing system. FCR was found better in $T_1$ followed by $T_2$, $T_3$ and $T_4$. Although in the present study no significant effect of yeast supplementation and housing could be observed but dry matter intake, mean feed intake and feed conversion ratio increases non significantly due to yeast supplementation and cage housing system. Chaudhary et al. (1995) found that feeding of yeast has not shown any improvement in feed gain ratio, which is also similar to observations of Maertens (1992). However, Cheeke et al. (1989) found an improvement in body weight and feed conversion ratio.

Yeast addition has caused an increase in feed cost from 22.87 to 28.27 Rs. (Table 2). Cost of feeding rabbits over the period of 45 days for $T_1$, $T_2$, $T_3$ and $T_4$ was found to be 73.18, 73.69, 69.52 and 71.89 while cost of feeding rabbits/kg of weight gain for $T_1$, $T_2$, $T_3$ and $T_4$ was found to be 75.73, 75.38, 75.92 and 77.82, respectively (Table 2). The results clearly indicated that feeding cost/animal was significantly higher in cage system as compared to pen system. In cages and pen system yeast supplementation further increases the cost of feeding/ animal.

While the results clearly indicated that feeding cost/kg body weight gain was significantly higher in pen system as compared to cage system. In cages and pen system, yeast supplementation further increased the cost of feeding/ animal. Thus it was found that rearing animals in cage system with yeast supplementation was more profitable as compared to pen system.

Among all the groups, the corresponding mean scores for different sensory attributes like colour, flavour, texture, tenderness, juiciness and over all acceptability were ranged from 7.2 to 7.9, 6.4 to 6.8, 6.9 to 7.5, 6.7 to 7.7, 6.7 to 7.7 and 7.1 to 7.7, respectively (Table 3) and all the samples were

<table>
<thead>
<tr>
<th>TABLE 2: Effect of different treatments on total dry matter intake (g), dry matter intake/ day (g), FCR and economics of rabbit feeding</th>
<th>$T_1$</th>
<th>$T_2$</th>
<th>$T_3$</th>
<th>$T_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Dry Matter Intake (g)</td>
<td>4759.24± 96.68</td>
<td>4787.67± 89.34</td>
<td>4521.34± 52.29</td>
<td>4670.72± 6.76</td>
</tr>
<tr>
<td>Dry Matter Intake (g)/ day</td>
<td>105.76± 2.14</td>
<td>106.39± 2.00</td>
<td>100.47± 2.33</td>
<td>103.79± 0.30</td>
</tr>
<tr>
<td>Feed Conversion Ratio</td>
<td>5.06± 0.08</td>
<td>4.92± 0.00</td>
<td>4.93± 0.00</td>
<td>4.89± 0.01</td>
</tr>
<tr>
<td>Cost of concentrate (Rs.)/ kg</td>
<td>22.87</td>
<td>28.27</td>
<td>22.27</td>
<td>28.27</td>
</tr>
<tr>
<td>Cost of berseem (Rs.)/ kg</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
</tr>
<tr>
<td>Cost of feeding (Rs.)/ animal</td>
<td>73.18± 0.34</td>
<td>73.69± 0.27</td>
<td>69.52± 0.31</td>
<td>71.89± 0.21</td>
</tr>
<tr>
<td>Cost of feeding (Rs.)/ kg body weight gain</td>
<td>75.73± 0.11</td>
<td>75.38± 0.12</td>
<td>75.92± 0.04</td>
<td>77.82± 0.18</td>
</tr>
</tbody>
</table>

Values bearing different superscripts in a row differ significantly at P< 0.05.
TABLE 3: Effect of different treatments on sensory evaluation of steam cooked rabbit meat

<table>
<thead>
<tr>
<th>Sensory attributes</th>
<th>Treatments</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean± SE, n= 6</td>
<td>Mean± SE, n= 6</td>
<td>Mean± SE, n= 6</td>
<td>Mean± SE, n= 6</td>
</tr>
<tr>
<td>Colour</td>
<td>7.50± 0.25</td>
<td>7.90± 0.31</td>
<td>7.20± 0.24</td>
<td>7.30± 0.26</td>
<td></td>
</tr>
<tr>
<td>Flavour</td>
<td>6.50± 0.27</td>
<td>6.80± 0.25</td>
<td>6.40± 0.19</td>
<td>6.50± 0.16</td>
<td></td>
</tr>
<tr>
<td>Texture</td>
<td>7.10± 0.27</td>
<td>7.50± 0.26</td>
<td>6.90± 0.27</td>
<td>7.00± 0.29</td>
<td></td>
</tr>
<tr>
<td>Tenderness</td>
<td>7.35±0.20</td>
<td>7.70±0.21</td>
<td>7.20±0.20</td>
<td>6.70±0.28</td>
<td></td>
</tr>
<tr>
<td>Juiciness</td>
<td>7.30±0.21</td>
<td>7.72±0.23</td>
<td>7.23±0.27</td>
<td>6.70±0.22</td>
<td></td>
</tr>
<tr>
<td>Overall Acceptability</td>
<td>7.38±0.24</td>
<td>7.70±0.21</td>
<td>7.20±0.20</td>
<td>7.10±0.27</td>
<td></td>
</tr>
</tbody>
</table>

Means with different superscripts row wise differ significantly (P<0.05).

highly acceptable. However, T2 samples showed higher scores in all the sensory attributes as compared to other treatments but the differences were non-significant, except, tenderness and juiciness scores. The significant differences were observed in tenderness (7.70) and juiciness (7.72) scores of T2 group as compared to T4 (6.70 and 6.70) steam cooked rabbit meat samples (Table 3). Metzger et al. (2003a), also found that tenderness and juiciness of cooked rabbit meat in pens was lower than the cage-housed rabbits. The tenderness and juiciness of the rabbit meat was not affected by yeast supplementation. These findings are in accordance with earlier studies of Onifade et al. (1999) and Lambertini et al. (2009).

However, T2 samples showed slightly higher scores in all the sensory attributes as compared to other treatments, but the differences were non-significant except tenderness and juiciness scores. Tenderness and juiciness scores were recorded significantly higher in T2 samples as compared to T4 group of cooked meat samples. Perhaps, the higher levels of protein, water and fat contents in T2 samples reflected as its better tenderness and juiciness scores as compared to T4 samples (Table 3).

In conclusion, it was found that, meat of the rabbits raised in cage system with yeast supplementation in feed was found more acceptable. The mean scores for different sensory attributes were highly acceptable in all the treatments. However, tenderness and juiciness scores were recorded significantly higher in rabbits raised under cage system with yeast supplementation as compared to rabbits raised under pen system with yeast supplementation. Feeding cost per kg body weight gain was significantly lower in rabbits raised under cage housing system without yeast supplementation. The results of the study inferred that rabbits reared in cage system and supplemented with 2% yeast in their standard diet is most profitable rearing method with most efficient feed economics and sensory attributes of cooked rabbit meat.

REFERENCES


