**Effects of nano selenium-enriched Bacillus subtilis supplementation on growth performance, nutrients digestibility and blood constituents of growing rabbits**

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**Objectives**

- Purpose of this study was to evaluate the efficiency of supplemental Bacillus in the forms of Bacillus subtilis alone (BS) and selenium nanoparticles-enriched Bacillus subtilis (SeNPBS) as probiotic feed additives on rabbits growth performance, nutrient digestibility, nitrogen balance and blood biochemical parameters.

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**Background**

- Both selenium (Se) and probiotic Bacillus own the virtues of regulating animal metabolism and improve the growth performance in growing rabbits.

**Material and Methods**

- **Probiotic Bacteria and feed preparation:** Bacillus subtilis (BS) was isolated from an environmental ecosystem in Egypt, characterized, and optimized to represent in vivo/vivo probiotic properties in order to determine the safety and efficacy as an animal feed additive. Fermentation of nano selenium-enriched Bacillus subtilis was prepared with sodium selenite supplemented into the BS culture medium. After fermentation, live BS without Se was 1 × 10^8 cfu/ml, while SeNPBS was 1 × 10^7 cfu/ml and SeNPBS reached 0.35 ppm. Each g of BS and SeNPBS were mixed with 1 kg of a carrier before being added to 1000 kg of animal feed.

- **Animals:** A total of 105 male New Zealand White growing rabbits aged 6 weeks, weighing 762 ± 13.8 g, were randomly distributed into five groups of 21 rabbits (7 replicates of 3 rabbits each) in a completely randomized experimental design.

- **Treatments:**
  - Control (with no probiotic).
  - Groups T1 and T2 were supplemented with probiotics Bacillus subtilis at doses 0.5 × 10^8 CFU/kg diet and 1 × 10^8 CFU/kg diet, respectively.
  - Groups T3 and T4 were supplemented with probiotics SeNPBS-enriched Bacillus subtilis at doses 0.5 × 10^8 CFU/kg diet and 1 × 10^8 CFU/kg diet, respectively.

- **Performance measurements:**
  - Body weight was calculated as the difference between the final and initial rabbit weight.
  - Feed intake was recorded daily during the experiment.
  - Average daily gain and feed conversion ratio were calculated.
  - Mortality rate was recorded daily and the percentage was recorded for each group at the end of the experiment.

- **Sampling:**
  - At the end of the experiment, rabbits were kept in metabolic cages to measure nutrient digestibility and nitrogen balance.
  - Blood sample were collected for serum biochemistry at the end of the experiment. Serum biochemistry were determined according to the manufacturers' instructions using commercial assay kits (Bio-diagnostic, Cairo, Egypt).
  - Data were analysed by analysis of variance using the GLM procedures of SAS.

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**Results**

**Figure 4. Effect of probiotic Bacillus subtilis supplementation on growth performance of rabbits.**

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>BS-enriched Bacillus</th>
<th>BS-enriched Bacillus</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed intake</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry matter</td>
<td>72.73 ± 1.75</td>
<td>72.75 ± 1.75</td>
<td>72.84 ± 1.73</td>
<td>0.03</td>
<td>0.001</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen balance (mg/dl)</td>
<td>69.03 ± 0.72</td>
<td>69.24 ± 0.73</td>
<td>69.27 ± 0.74</td>
<td>0.17</td>
<td>0.044</td>
</tr>
<tr>
<td>Weight gain</td>
<td>66.72 ± 0.85</td>
<td>67.18 ± 0.86</td>
<td>67.26 ± 0.87</td>
<td>0.03</td>
<td>0.0002</td>
</tr>
<tr>
<td>Serum protein</td>
<td>38.13 ± 0.54</td>
<td>38.14 ± 0.54</td>
<td>38.15 ± 0.54</td>
<td>0.29</td>
<td>0.002</td>
</tr>
<tr>
<td>Mortality</td>
<td>0.12 ± 0.06</td>
<td>0.11 ± 0.06</td>
<td>0.11 ± 0.06</td>
<td>0.01</td>
<td>0.0004</td>
</tr>
</tbody>
</table>

**Table 1. Effect of probiotic Bacillus subtilis supplementation on apparent nutrient digestibility and nitrogen balance of rabbits.**

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**Conclusions**

Bacillus probiotics in the forms of Bacillus subtilis alone, as well as SeNPBS-enriched Bacillus subtilis, are alternatives natural additives that promote growth performance, nutrient digestibility, nitrogen balance, and lower blood lipids in rabbits. Probiotics, in both forms, are promising natural feed supplements with favorable productive and physiological effects.