EFFECT OF DIETARY BIOTIN SUPPLEMENTATION ON 
SOW REPRODUCTIVE PERFORMANCE AND SOUNDNESS
AND PIG GROWTH AND MORTALITY1,2,3

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ABSTRACT

A 3-yr study was conducted to evaluate the effect of dietary biotin supplementation on
the reproductive performance of 90 sows and gilts, and on the pre-weaning growth and
mortality of 223 litters. Corn-soybean meal-based diets supplemented with either 0 or 440
µg/kg d-biotin were fed to sows throughout their reproductive cycle. Biotin supplementation
had no beneficial effect (P > .10) on 107-d sow weight, sow weight at weaning,
weaning to estrus interval, foot lesion score, hair loss score, structural soundness score,
number of pigs born, number and percentage of pigs born alive or number and percentage
of pigs alive at 21 d of age. Biotin supplementation had no effect (P > .10) on pig growth
or mortality to 21 d of age. These data do not support the concept that biotin
supplementation of sow diets is needed.

Key Words: Sows, Pigs, Biotin, Reproduction

Introduction

Biotin is required for CO₂ transfer and
activation in carbohydrate metabolism and is a cofactor in other processes involved in protein
and lipid metabolism (Balnave, 1977; McDowell, 1989). Experimentally produced biotin
deficiencies in swine (Cunha et al., 1946;
Hamilton et al., 1982; Misir et al., 1986) as
well as in other species (Kratzer et al., 1988;
Watanabe and Endo, 1989) have demonstrated
that biotin is essential as a B vitamin.
Recently, researchers have noted a similarity
between the symptoms of experimentally
produced biotin deficiency (dermatitis, alopec-
ia, spasticity and edema of the feet, foot
lesions, fatty livers and impaired reproductive
performance) and clinical abnormalities in
sows (Brooks et al., 1977; Grandhi and Strain,
1980; Penny et al., 1981). These symptoms
historically have been attributed to poor
management and to environmental and breed-
ing stress.

Biotin supplementation of sow diets has
been reported to improve (Brooks et al., 1977;
Penny et al., 1981; Tribble et al., 1984; Webb
et al., 1984; Bryant et al., 1985a,b,c) or to have
no effect (Easter et al., 1979; Grandhi and
Strain, 1980; Hamilton and Veum, 1984) on
sow reproductive performance. Therefore, this
study was conducted to investigate the effects
of supplemental dietary biotin on sow repro-
ductive performance and soundness and pig
growth and mortality to 21 d of age.

Materials and Methods

Ninety crossbred sows fed corn-soybean
meal-based, gestation-lactation diets, supple-
mented with either 0 or 440 µg/kg d-biotin
(Table 1), were used in a 3-yr study. Initially,
sows were allotted randomly to treatment
All litters in a contemporary farrowing group were weaned when the youngest litter was 28 d of age. Age at weaning never exceeded 42 d. Cross-fostering of pigs was not practiced and litters were not equalized. Sows were rebred on the first estrus after weaning. The breeding period ended 10 d after weaning or after 23 females were bred. Days to estrus was recorded regardless of whether estrus was detected after the breeding period ended. Sows were culled if they failed to return to estrus during the immediate postweaning breeding period or if they did not exhibit estrus during two subsequent breeding periods. 

The diet (Table 1) was supplemented with either 0 or 440 µg/kg d-biotin. Diets were adequate in all nutrients for gestating and lactating swine (NRC, 1988) and were fed throughout the complete reproductive cycle. From d 107 of gestation to 7 d postfarrowing, 20% of each diet was replaced with wheat bran. Sows were fed 1.8 kg/d during gestation and 1.4 kg/d plus .45 kg/pig during each day of lactation. The complete diets were analyzed for biotin content and found to contain 160 ± 22 and 443 ± 32 µg/kg for the basal and basal + biotin diets, respectively. The basal and basal + biotin diet means ± standard deviations were obtained from 35 and 39 diet samples, respectively. We have no explanation for the difference in calculated (600 µg/kg) vs analyzed (443 µg/kg) biotin content of the basal + biotin diet. 

### Table 1. Percentage Composition of Diets

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Basal</th>
<th>Basal + biotin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground corn</td>
<td>81.28</td>
<td>81.08</td>
</tr>
<tr>
<td>Soybean meal (44% CP)</td>
<td>15.93</td>
<td>15.93</td>
</tr>
<tr>
<td>Defluorinated rock phosphate</td>
<td>1.67</td>
<td>1.67</td>
</tr>
<tr>
<td>Oyster shell flour</td>
<td>.57</td>
<td>.57</td>
</tr>
<tr>
<td>Salt</td>
<td>.25</td>
<td>.25</td>
</tr>
<tr>
<td>Trace mineral mix b</td>
<td>.05</td>
<td>.05</td>
</tr>
<tr>
<td>Vitamin mix c</td>
<td>.25</td>
<td>.25</td>
</tr>
<tr>
<td>Biotin premix d</td>
<td>.20</td>
<td></td>
</tr>
</tbody>
</table>

*Formulated to contain the following: 14% CP, .66% lysine, .8% Ca, .6% P and 3,202 kcal ME/kg.

Trace mineralized salt provided the following per kilogram of diet: Zn, 75 mg; Fe, 87.5 mg; Mn, 30 mg; Cu, 8.75 mg; I, 1 mg; Ca, 9 mg; and salt, 2.5 g.

Trace mineralized salt provided the following per kilogram of diet: vitamin A, 4,400 IU; vitamin D3, 440 IU; vitamin E, 11 µV; riboflavin, 4.4 mg; d-pantothenic acid, 22.0 mg; niacin, 22.0 mg; vitamin B12, 22 pg and choline chloride, 440 mg.

Biotin premix provided 440 µg d-biotin/kg diet.

Biotin content of feed was monitored (Hoffmann-La Roche, Inc., Nutley, NJ) using a microbiological growth assay. Overall mean biotin levels were approximately 160 ± 22 and 443 ± 32 µg/kg for basal and basal + biotin diets, respectively.

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Hoffmann-La Roche, Inc., Nutley, NJ.
Sows were weighed on d 107 of gestation and at the time pigs were weaned. After weaning, sows were evaluated and scored independently by three individuals for incidence and severity of foot lesions, hair loss and structural soundness. Foot lesions were scored according to the system adopted by Brooks et al. (1977). Each foot lesion was given a score from 1 to 5, with a score of 1 indicating small minor lesions and a score of 5 indicating large severe lesions. Hair loss was assigned a score from 1 to 5, with a score of 1 representing no hair loss and a score of 5 representing extensive hair loss. Structural soundness was given a value between 1 and 15, with a score of 1 indicating the sow was structurally correct, sound and free-moving, and a score of 15 indicating severe lameness inhibiting her ability to walk.

Each pig was weighed at farrowing and at 21 d of age; number of pigs born, number born alive and number alive at 21 d of age were recorded to evaluate sow reproductive performance.

Data were analyzed using ANOVA procedures appropriate for repeated measure design (Steel and Torrie, 1980). Independent effects in the model were dietary treatment, sow, farrowing number, sow within treatment and treatment by farrowing interaction. Treatment mean differences were tested using sow within treatment mean square as the error term. Using the same model, pig growth and mortality to 21 d were analyzed with litter as the experimental unit. The variable, number of pigs born, was used as a covariate in the model to test the effects of biotin on percentage of pigs born alive, number of pigs at 21 d, percentage of pigs alive at 21 d, and pig weight at 21 d. The covariate was significant ($P < .05$) for each trait.

**Results and Discussion**

The sows in both treatment groups were on the study for various lengths of time and for a different number of farrowings (Table 2). Therefore, the results presented here are divided into two data sets. One set contains data from all sows and litters irrespective of the number of farrowings they contributed to the study (Table 3). The second data set contains only sows that completed at least four farrowings during the experimental period (Table 4). Although no farrowing x treatment interactions were detected ($P > .10$) in the data

**TABLE 2. NUMBER OF LITTERS PER Farrowing GROUP**

<table>
<thead>
<tr>
<th>Farrowing number</th>
<th>Dietary treatment</th>
<th>Basal</th>
<th>Basal + biotin</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>45</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Second</td>
<td>29</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Third</td>
<td>20</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Fourth</td>
<td>11</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Fifth</td>
<td>7</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Average ± SD</td>
<td>2.5 ± 1.5</td>
<td>2.5 ± 1.3</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 4. EFFECT OF DIETARY BIOTIN ON THE REPRODUCTIVE PERFORMANCE OF SOWS COMPLETING FOUR FARROWINGS

<table>
<thead>
<tr>
<th>Item</th>
<th>Basal</th>
<th>Basal + biotin</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>107-d sow wt, kg</td>
<td>219.6</td>
<td>199.7</td>
<td>9.2</td>
</tr>
<tr>
<td>Sow wt at weaning, kg</td>
<td>196.7</td>
<td>185.2</td>
<td>7.7</td>
</tr>
<tr>
<td>Foot score</td>
<td>7.16</td>
<td>6.48</td>
<td>1.38</td>
</tr>
<tr>
<td>Hair score</td>
<td>1.68</td>
<td>1.58</td>
<td>.11</td>
</tr>
<tr>
<td>Soundness score</td>
<td>2.38</td>
<td>2.23</td>
<td>.22</td>
</tr>
<tr>
<td>Reprobreeding interval, d</td>
<td>4.98</td>
<td>3.25</td>
<td>.42</td>
</tr>
<tr>
<td>No. of pigs born</td>
<td>11.41</td>
<td>10.66</td>
<td>.58</td>
</tr>
<tr>
<td>Percentage born alive</td>
<td>78.82</td>
<td>81.91</td>
<td>2.13</td>
</tr>
<tr>
<td>Pig birth wt, kg</td>
<td>1.58</td>
<td>1.45</td>
<td>.08</td>
</tr>
<tr>
<td>No. of pigs at 21 d</td>
<td>7.42</td>
<td>7.56</td>
<td>.34</td>
</tr>
<tr>
<td>Percentage alive at 21 d</td>
<td>89.00</td>
<td>85.82</td>
<td>2.38</td>
</tr>
<tr>
<td>Pig 21-d wt, kg&lt;sup&gt;c&lt;/sup&gt;</td>
<td>5.15</td>
<td>4.73</td>
<td>.13</td>
</tr>
</tbody>
</table>

<sup>a</sup>Data are least square means of 44 (basal) or 48 (basal + biotin) litters representing 11 and 12 sows, respectively.

<sup>b</sup>As a percentage of pigs born alive.

<sup>c</sup>Biotin effect, P < .03.

...of our experiment, we felt it necessary to equalize farrowing number across treatments and to present this second data set. In addition, Brooks et al. (1977) and Bryant et al. (1985b) have reported that biotin supplementation increased the number of total and live pigs farrowed only after the first parity. Therefore, all first farrowing data were removed from the second data set and the remaining data were reanalyzed. No significant differences (P > .10) in this analysis deviated from either of the previously described statistical analyses. Thus, this final data set is not presented.

Feeding sows a corn-soybean meal-based diet supplemented with 440 μg/kg d-biotin had no effect (P > .10) on reproductive performance, soundness, foot lesions, hair loss or pig growth and mortality of sows when only the data from sows that completed at least four farrowings (Table 4) were analyzed. In fact, weight of pigs at 21 d was reduced (P < .03) by biotin supplementation.

Several studies have shown that dietary biotin supplementation reduces the incidence and/or severity of foot lesions and cracks in sows (Brooks et al., 1977; Webb et al., 1984; Bryant et al., 1985a,c). Although in our experiment foot lesion scores of sows fed biotin-supplemented diets tended to be lower than those of sows fed unsupplemented diets (Tables 3 and 4), this difference did not approach significance (P > .6) due to the variability of this trait (CV = 77 and 76 for the foot lesion score data in Tables 3 and 4, respectively). Attempting to normalize distribution of foot lesion, hair and soundness score data by performing a log(1) transformation (Steel and Torrie, 1980) did not change the probability levels for these criteria. However, our results are similar to those of Hamilton and Veum (1984), who found no improvements from added biotin in the overall appearance or soundness of feet and legs in sows.

Brooks et al. (1977) and Bryant et al. (1985a) also have reported that biotin reduced the weaning to rebreeding interval. Our data support those of Grandhi and Strain (1980), Hamilton and Veum (1984) and Tribble et al.
The discrepancy in the efficacy of biotin practices used in the swine industry today. Environmental, nutritional and management practices used in the swine industry today. Grandhi and Strain (1980) reported that biotin supplementation of gestation and lactation diets containing barley and wheat did not improve reproductive performance. However, Misir and Blair (1988a) reported that the biotin content of many feedstuffs was adequate, which was considered is housing conditions.

Biotin in corn has been reported to be nearly completely available to poultry (Frigg, 1976; Misir and Blair, 1988b). In our study and in the studies of Easter et al. (1979) and Hamilton and Veum (1984), in which essentially no beneficial effects of biotin supplementation were found, corn was used exclusively as the grain source. Sauer et al. (1988), however, reported that only 4% of the biotin in corn was digested by growing barrows fitted with T-cannulas, and that, although the total biotin content of many feedstuffs was adequate, its availability to the pig was low. Hamilton and Veum (1984) have suggested that overdrying, poor storage conditions and presence of mold may reduce the availability of biotin in corn. This could account for some of the beneficial effects of biotin supplementation reported by those feeding corn-based diets.

Another important factor that should be considered is housing conditions. Type of flooring may affect the incidence and severity of foot lesions and soundness. Access to feces or pasture also will provide the sow with additional biotin. In our study, sows were kept in total confinement pens with partially slatted floors, allowing access to fecal material. Microbial production of biotin in the large intestine may provide a substantial amount of biotin under some conditions. Although we do not know how much, if any, of microbiologically produced nutrients can be absorbed in the hindgut, through coprophagy sows would obtain microbial biotin to supplement their dietary intake.

Implications

Biotin supplementation of corn-soybean meal diets did not improve reproductive performance of sows or the preweaning performance of their pigs. However, under certain environmental and nutritional conditions biotin supplementation might be warranted.

Literature Cited


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