METABOLIC AND BEHAVIORAL PARAMETERS IN NEWBORN PIGLETS IN RELATION TO BIRTH ORDER

PARAMETRII METABOLICI ȘI COMPORTAMENTALI LA PURCEOII NOUNĂȘCUȚI ÎN RAPORT CU ORDINEA NAȘTERII

SĂRÂNDAN H.*, MANEA C.*, TOMA OLGA*, SĂRÂNDAN M.*, VIȘOIU G.**

Faculty of Veterinary Medicine Timișoara

The experiment had 2 phases: During the first phase 19 sows were monitored during farrowing; the piglets were numbered according to birth order, they were weighed and there were recorded the time each piglet was born and when it first suckled. There was calculated the time from the beginning of the farrowing until the time each piglet was born (ΔTNPP) and the time from birth until the first suckle (ΔTPS). A statistical correlation was established between these parameters. During the second experimental phase, for 49 piglets from 5 sows were determined: birth weight, ΔTPS, glycemia at birth (G₀) and after the first suckle (G₁), rectal temperature at birth (T₀) and after the first suckles (T₁). This data was statistically analyzed using the Mann-Whitney U test. Respecting the birth order, ΔTPS is shorter for piglets born last (p<0.05). Average ΔTPS was 23.04±2.49 minutes; during this time glycemia rises from 58.35 mg% to 64.35 mg% and rectal temperature drops from 38.58°C to 37.35°C. T₀ is positively correlated with G₀ (p<0.01) with G₁ (p<0.01) and T₁ (p<0.01). G₀ is highly correlated to G₁ (r=0.8855; p=0)

Key words: newborn piglets, first suckle, glycemia, temperature.

Introduction

Considering the industrial breeding facilities for swine, the better knowledge of feeding and social behavior will allow to improve the breeding technology, thus benefiting animal productivity.

Considerable research has already been conducted regarding piglets’ behavior from birth to weaning (1; 2; 3; 4; 5; 8), motivated by the fact that most economical losses are recorded within the suckling period.

Feeding behavior is driven by hunger and thirst, but in suckling piglets the regulation of feed intake is not balanced energy-dependent (7). Furthermore, birth hypoxia, genetic heritage and the sudden change from the intra-uterine life to the extra-uterine severely reflect on the piglets’ survival chance.
Considering the above, this paper is a contribution to the better knowledge of piglets’ feeding behavior during the first hour of life, an attempt to understand the metabolic mechanisms it is governed by. The answer to this problem may contribute to a reduction in piglets’ mortality before weaning while also improving their weight gain.

**Materials and Methods**

The experiments were performed in an industrial pig breeding complex with an average population counting 13500. Investigations were done in two phases: the first was meant to establish a relationship between birth order, body weight, and time from the beginning of farrowing to the first milk intake; during phase two, an attempt was made to determine the motivation of piglets’ behavior by measuring glycaemia and rectal temperature at birth and immediately prior to the first suckle.

For the first experimental phase, 19 sows were observed: 4 sows with 8 piglets, 4 sows with 9 piglets, 3 sows with 10 piglets, 6 sows with 11 piglets and 2 sows with 12 piglets each.

At birth, the piglets were weighed and individualized, and times of birth and first suckle recorded.

The data was analyzed to determine the time interval from the birth of each piglet to the first milk intake (ΔTPS) as well as the interval from the beginning of farrowing to the birth of each piglet (ΔTNPP). Average values were calculated for ΔTPS and ΔTNPP separately for litters comprising the same number of piglets, as well as average values for all the piglets with the same number (in farrowing order). Statistical correlations were determined separately, per number of piglets farrowed per sow and overall, using the non-parametrical Mann-Whitney U Test.

For the second experimental phase, five sows were observed, with litters of 5, 6, 9, 14 and 15 piglets; based on glycaemia measurements and rectal temperature values as well as on the interval to first suckle and body weight, correlations were established in order to explain the piglets’ feeding behavior. Considering literature data, an attempt was made to estimate birth hypoxia in relation to glycaemia. Also, average rectal temperatures (Tº) and average glycaemia (G) were calculated for all piglets at birth and at the time of the first milk intake, as well as the differences ΔG and ΔTº for the interpretation.

The average air temperature in the farrowing pen at piglets’ height was determined at 23±2.5ºC).

**Results and Discussions**

Table 1 shows the average values of body weight (MC), the time interval from first suckle (ΔTPS) and ΔTNPP in relation to the number of piglets born in a litter (LF).
Average body weight, average time spent to first suckle and average time from the beginning of farrowing to each piglet’s birth (ΔTNPP)

<table>
<thead>
<tr>
<th>Litter of</th>
<th>8 piglets</th>
<th>9 piglets</th>
<th>10 piglets</th>
<th>11 piglets</th>
<th>12 piglets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average body weight (kg)</strong></td>
<td>1.33±0.04</td>
<td>1.36±0.04</td>
<td>1.47±0.03</td>
<td>1.34±0.03</td>
<td>1.51±0.06</td>
</tr>
<tr>
<td><strong>ΔTPS (minutes)</strong></td>
<td>20.16±3.71</td>
<td>25.42±4.12</td>
<td>22.5±1.77</td>
<td>19.7±1.44</td>
<td>26.71±4.32</td>
</tr>
<tr>
<td><strong>ΔTNPP (minutes)</strong></td>
<td>63.97±15.87</td>
<td>56.94±12.79</td>
<td>66.16±11.13</td>
<td>52.74±8.96</td>
<td>68.83±13.43</td>
</tr>
</tbody>
</table>

Overall, it was observed that the average weight of the piglets was 1.41±0.06kg while the average time from birth to first suckle (ΔTPS) was 23.04±2.49 minutes, values similar to those in the available literature.

Comparing these parameters for piglets with the same number in birth order, it was observed that in birth order, the later a piglet is delivered, the shorter the time it needs to find the udder and achieve a first suckle (Table 2, Figure 1). This relationship was also observed by Casellas et al., (3) who also established the relationship between ΔTPS and the rectal temperature of piglets at birth.

### Table 2

Average values of the relationship between birth order and time interval to first milk intake (ΔTPS)

<table>
<thead>
<tr>
<th>Birth order</th>
<th>Average body weight (kg)</th>
<th>ΔTPS (minutes)</th>
<th>ΔTNPP (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; piglet</td>
<td>1.37</td>
<td>39</td>
<td>0</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; piglet</td>
<td>1.35</td>
<td>25.73</td>
<td>19</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; piglet</td>
<td>1.3</td>
<td>22.05</td>
<td>32.11</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt; piglet</td>
<td>1.42</td>
<td>19.47</td>
<td>46</td>
</tr>
<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt; piglet</td>
<td>1.43</td>
<td>18.73</td>
<td>59.84</td>
</tr>
<tr>
<td>6&lt;sup&gt;th&lt;/sup&gt; piglet</td>
<td>1.34</td>
<td>21.42</td>
<td>70.52</td>
</tr>
<tr>
<td>7&lt;sup&gt;th&lt;/sup&gt; piglet</td>
<td>1.43</td>
<td>16.47</td>
<td>79.1</td>
</tr>
<tr>
<td>8&lt;sup&gt;th&lt;/sup&gt; piglet</td>
<td>1.34</td>
<td>22.05</td>
<td>90.89</td>
</tr>
<tr>
<td>9&lt;sup&gt;th&lt;/sup&gt; piglet</td>
<td>1.38</td>
<td>18.53</td>
<td>96.8</td>
</tr>
<tr>
<td>10&lt;sup&gt;th&lt;/sup&gt; piglet</td>
<td>1.54</td>
<td>19.63</td>
<td>100</td>
</tr>
<tr>
<td>11&lt;sup&gt;th&lt;/sup&gt; piglet</td>
<td>1.25</td>
<td>17.62</td>
<td>105.87</td>
</tr>
<tr>
<td>12&lt;sup&gt;th&lt;/sup&gt; piglet</td>
<td>1.75</td>
<td>14.5</td>
<td>135.5</td>
</tr>
</tbody>
</table>
Statistically, between body weight and ΔTPS the correlation is week, statistically not significant (p>0.05), which contradicts the results of Pegorier et al. (8); the correlation between body weight and ΔTNPP is average and positive, but not significant statistically (p>0.05).

Experimentally, glycaemia and rectal temperature values recorded for 50 piglets from five sows were analyzed to determine average values at birth and at the time of the first milk intake, as well as the gradient of glycaemia and rectal temperature.

<table>
<thead>
<tr>
<th></th>
<th>G₀</th>
<th>G₁</th>
<th>T₀</th>
<th>T₁</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>58.35 ± 9.88</td>
<td>64.35 ± 13.51</td>
<td>38.58 ± 0.44</td>
<td>37.35 ± 0.66</td>
</tr>
</tbody>
</table>

Based on this data, correlation coefficients “r” (Spearman) and statistical probability between measured parameters were calculated (table 5); the following positive correlations were obtained:
Table 5
Correlation coefficients “r” (Spearman) and statistical probability between all measured parameters

<table>
<thead>
<tr>
<th>Tested parameter</th>
<th>Spearman r</th>
<th>p Value</th>
<th>Statistically significant correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON-G₀</td>
<td>0.7657</td>
<td>0.0009</td>
<td>p&lt;0.01</td>
</tr>
<tr>
<td>ON-G₁</td>
<td>0.6</td>
<td>0.0181</td>
<td>p&lt;0.05</td>
</tr>
<tr>
<td>ON-T₀</td>
<td>0.7529</td>
<td>0.0012</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>ON-T₁</td>
<td>0.7226</td>
<td>0.0023</td>
<td>p&lt;0.01</td>
</tr>
<tr>
<td>G₀-G₁</td>
<td>0.8865</td>
<td>0.0000</td>
<td>P=0</td>
</tr>
<tr>
<td>G₀-T₀</td>
<td>0.7203</td>
<td>0.0025</td>
<td>p&lt;0.01</td>
</tr>
<tr>
<td>G₀-T₁</td>
<td>0.7637</td>
<td>0.0009</td>
<td>p&lt;0.01</td>
</tr>
<tr>
<td>T₀-T₁</td>
<td>0.6595</td>
<td>0.0075</td>
<td>p&lt;0.01</td>
</tr>
<tr>
<td>T₁-MC</td>
<td>0.652</td>
<td>0.0084</td>
<td>p&lt;0.01</td>
</tr>
</tbody>
</table>

ON – order of birth
ΔTPS – time from birth to first suckle
G₀ – glycaemia at birth
G₁ – glycaemia at first suckle
ΔG – difference between glycaemia values at birth and at first suckle
T₀ – rectal temperature at birth
T₁ – rectal temperature at first suckle
ΔT – difference between temperature values at birth and at first suckle

- Birth order correlates well with birth glycaemia (p<0.01).
- Glycaemia at first suckle correlates well with birth order (p<0.05), birth order correlates well with rectal temperature at birth (p<0.001) and at the time of the first suckle (p<0.01).
- Piglets’ body weight at birth correlates well with rectal temperature at first suckle (p<0.01).
- Rectal temperature at birth correlates with rectal temperature at first suckle (p<0.01), with birth glycaemia (p<0.01) and glycaemia at first milk intake (p<0.01).
- Also, there is a very strong correlation (r=0.8855; p=0) between birth glycaemia and glycaemia at first suckle.

In comparison to the results obtained by Casellas et al., (3), our experiment also shows a positive correlation between birth order and rectal temperature at first suckle (p<0.01) and respectively a closer correlation with rectal temperature at birth (p<0.0001).

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Casellas et al., (3) found a decrease in rectal temperature of 1.1°C one hour after birth, and an average interval until the first suckle of 39.9±1.4 minutes, far greater (by 173.2%) than the value obtained in our experiment (23.04±2.49 minutes).

The increase in glycaemia correlates positively to the increase in pCO$_2$ and the decrease of the rectal temperature (p<0.0001), thus determining a slower access to the udder (4).

The increase in glycaemia seems to be due to an increase in the level of plasmatic glucagon (11); it is possible that the glucagon secretion is stimulated by the increase in pCO$_2$, lactate, or the decrease of pH, however this hypothesis requires further investigation.

The increase of glycaemia was also observed at 12 hours after birth (6), by 14 units, suggesting that liver glucose-neo-genesis is stimulated either by a pCO$_2$ correlated mechanism at birth, or by colostrum intake which has the greatest stimulating effect on glucose-neo-genesis. 24 hours after birth, the hyperglycemias is still maintained (57mg% compared to 48mg% at birth) (6), as 60% of piglets daily glucose requirement is assured by liver glucose-neo-genesis (9).

An important influence on piglets’ glycaemia is that of the perinatal cortisol secretion (10).

The entire ensemble of metabolic changes markedly reflects on the integrity and growth of the digestive tract after birth (10).

**Conclusions**

- In birth order, the later a piglet is born, the less time it requires to find the udder and achieve the first suckle (ΔTPS) (p<0.05).
- Piglets’ body weight at birth correlates positively, but not statistically significant, with the birth order.
- The average time interval ΔTPS was 23.04±2.49 minutes; within this interval, glycaemia increases from 58.35mg% to 64.35mg%, while the rectal temperature drops from 38.58°C to 37.35°C.
- The birth order correlates positively with birth glycaemia (p<0.01), glycaemia at first suckle (p<0.05), rectal temperature at birth (p<0.001) and at first suckle (p<0.01).
- Birth glycaemia correlates very well with glycaemia at first suckle (r=0.8855; p=0).

**Bibliography**


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