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# Effects of energy supplementation to neonatal (very) low birth weight piglets on mortality, weaning weight, daily weight gain and colostrum intake☆

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ABSTRACT

Pre-weaning piglet mortality is an important economic and welfare problem in the commercial pig industry. Energy deficit is one of the main pre-disposing risk factors for piglet mortality. Management strategies, such as energy supplementation to neonatal piglets, may reduce pre-weaning mortality. In practice, energy supplementation might be implemented in the farrowing management. Energy supplements may provide energy to neonatal piglets as well as improve their colostrum intake. Therefore, the present study investigated the effect of a commercial energy supplement (Vigorol®) to neonatal low birth weight piglets on mortality, weaning weight, daily weight gain as well as the effect on colostrum intake. In the treatment group, 72 very low (VLBW $<$ 1.00 kg) and 77 low (1 kg $\leq$ LBW $\leq$ 1.20 kg) birth weight piglets out of 306 total live born piglets from 22 litters were orally supplemented at birth and 8–12 h after birth. In the control group, 81 VLBW and 74 LBW piglets out of 340 total live born piglets from 24 litters were not supplemented. Mortality till day 3 was lower ($p<0.001$) and tended to be lower ($p=0.07$) in supplemented versus control VLBW and LBW piglets, respectively. In general, mortality till day 3 also tended to be lower ($p=0.06$) in supplemented piglets. Mortality till day 7 ($p<0.001$) and day 21 ($p<0.001$) remained lower in supplemented VLBW piglets. No difference was observed regarding LBW and overall mortality till day 7 ($p=0.64$; $p=0.24$) and day 21 ($p=0.61$; $p=0.23$). Weaning weights were lower ($p=0.04$) in the treatment than in the control group. Daily weight gain ($p=0.42$), colostrum intake ($p=0.56$), nor colostrum yield ($p=0.21$) differed between the groups. Colostrum intake was numerically ($p=0.53$) more uniform among litter mates in the treatment versus the control group. This study demonstrated that energy supplementation to neonatal (V)LBW piglets is a way of reducing piglet mortality by providing direct energy, rather than by improving (the uniformity of) colostrum intake.


## 1. Introduction

Pre-weaning piglet mortality is an important economic and welfare problem. Crushing, starvation and chilling are the main causes of piglet mortality (Alonso-Spilsbury et al., 2007; Edwards, 2002; Herpin et al., 2002). Early and sufficient energy supply is of utmost importance for neonatal survival (Andersen et al., 2009; Edwards, 2002; Theil et al., 2014b). Neonatal piglets require energy for growth and maintenance. Maintenance includes physical activity and to a great extent thermoregulation (Herpin et al., 2002; Le Dividich et al., 2005). The energy demands of neonatal pigs have to be met by body reserves and by colostrum. However, glycogen reserves are rapidly depleted, body protein catabolism is low during the neonatal period and only a small proportion of the low total fat amount is available for mobilization (Le Dividich et al., 1994, 2005). In addition, selection for increased litter size and leaner carcasses have resulted in less energy reserves at birth (Herpin et al., 1993). Therefore, energy provided by colostrum is imperative for neonatal survival. Colostrum intake may be enhanced by boosters supplying the energy needed to compete with littermates for a functional teat (Le Dividich et al., 2005). Compared to normal birth weight piglets, (very) low birth weight piglets are at particular risk to die as they are less competitive for colostrum intake in addition to their higher energy demands per unit of body weight and lower energy reserves (Baxter et al., 2008; Devillers et al., 2011; Herpin et al., 2002). As the proportion of (very) low birth weight piglets has increased with selection for increased litter size (Quiniou et al., 2002), strategies are needed to reduce (low birth weight) piglet pre-weaning mortality.

Several supplements are marketed to improve neonates' energy status and survival rate, however scientific evidence of their efficacy

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is scarce (De Vos et al., 2014). Therefore, the present study was conducted to investigate the effect of a commercial energy supplement to neonatal (very) low birth weight piglets on mortality, daily weight gain and weaning weight. As energy supplements may enable (very) low birth weight piglets to compete (more) successfully with their heavier littermates for colostrum, considering the crucial role of colostral energy to neonatal survival and regarding the lack of field trials investigating the effect of management routines on colostrum intake, the present study investigated also the effect of supplementation on colostrum intake.

## 2. Materials and methods

### 2.1. Study population

The study was performed during July and August 2013 at a commercial farm in Flanders (northern Belgium) with 1700 Pig Improvement Company (PIC) sows in a 2-week batch system. Sows were inseminated with semen from Piétrain boars. They were group housed with 15 animals per pen from day 29 until day 107 of gestation when they were moved to the farrowing house. Day 0 was defined as the day of first insemination. During gestation sows were fed according to their (visual) body condition. On average the total amount of feed was 3 kg $sow^{-1}$ $day^{-1}$. Per pen two feeders dropped a small amount of the gestation diet (90% DM, 16% CP, 4% CF, 4% CFib and 6% CA) during five feeding times throughout the day in order to reduce stress at the two feeders per 15 sows. From day 108 of gestation until weaning, sows were individually housed in conventional farrowing crates. Farrowing pens were 2.8 m by 2.3 m. From day 108 of gestation until day 2 of lactation, sows received a transition diet (90% DM, 13% CP, 5% CF, 4% CFib and 5% CA) three times a day (3.3 $kg \cdot sow^{-1} \cdot day^{-1}$). From day 3 of lactation until weaning, sows received four times a day a lactation diet (91% DM, 14% CP, 6% CF, 3% CFib and 3% CA) of which the amount increased with 0.5 and 1.0 kg per day for primi- and multiparous sows, respectively, till a maximum feed intake around day seven to ten was reached. Sows had free access to fresh drinking water (flow 1.5–2 L/min) in the gestation and farrowing unit. Nest building material was not offered to the sows as this was not technically feasible with the slurry system in the farrowing rooms. The ambient temperature in the farrowing house was set to 24 °C. Floor heating and infrared lamps were used to create a piglet microclimate of 30 °C. Cross fostering to standardize litter size was not allowed before the second day of life, and only between sows within a treatment group. During the trial, only two piglets were cross-fostered between two control sows. Piglet husbandry procedures (e.g. placing official ear tags, iron injection) were performed at day 3 of lactation. Creep feed (91% DM, 19% CP, 8% CF, 3% CFib and 7% CA) was offered from the 3rd day of lactation. Weaning took place at 22 ± 2 days into specialized housings which were emptied and thoroughly cleaned and disinfected before the introduction of a new group as per EU regulations. Sows and piglets were daily checked for health or eating problems.

### 2.2. Experimental design

The experiment was approved by the Ethical Committee of the Faculty of Veterinary Medicine, Ghent University (EC2013/98). Parity and insemination date were taken into account to be uniformly distributed across both treatment groups before entering the farrowing unit. A total of 56 sows were randomly assigned to a treatment or a control group. Sows were continuously supervised 24 h a day throughout one week. Based on occurrence of farrowing during that week and based on a minimum litter size of 10 live born piglets, 22 and 24 sows were enrolled in the treatment and control group, respectively. Farrowing was not induced and manual birth assistance was only performed when birth interval between two piglets exceeded one hour. Immediately after birth, piglets were dried, got individual trial ear tags and were weighed before first suckling. Very low birth weight (VLBW) piglets were defined as live born piglets with a birth weight less than 1.00 kg. Studies on birth weight define low birth weight piglets as piglets having a birth weight less than 1.00 kg and/or less than the lower quartile of birth weights (Michiels et al., 2013; Rehfeldt et al., 2008). It is well reported that piglets with a birth weight less than 1.00 kg have a high risk to die within 24 h (Quesnel et al., 2008; Quiniou et al., 2002). As the present study aimed to investigate the effect of energy supplementation not only on early mortality, but also on pre-weaning mortality, performance and colostrum intake, thresholds for low birth weight (LBW) piglets were set at 1.00 and 1.20 kg. The upper threshold of 1.20 kg was set according to the lightest half of live born piglets, based on the birth weight quartiles in a previous study on the present farm (Declerck et al., 2015). In the treatment group **VLBW and LBW** piglets were supplemented (Vigorol®, Ecuphar, Oostkamp, Belgium) at birth. Piglets were fixed with one hand and the small tube of the pump was carefully inserted in the mouth. One press on the pump corresponded to a release of 3 g. Piglets were placed back at the same place where they had been taken up (mostly behind the sows' vulva). The **VLBW and LBW** piglets in the treatment group were supplemented a second time at 8–12 h after birth according to the commercial booster instructions. The main components of Vigorol® (80% DM, 0% CP, 67% CF, 0% CFib and 0% CA) are soya oil (330 g/kg) and coconut oil (380 g/kg). The energy content of the supplement is 2718 kJ/100 g. Fatty acid composition of the product is presented in Table 1. The fatty acids are mainly medium chain fatty acids (**MCFA**) (6–12 carbons).

### 2.3. Parameters of comparison

From birth till weaning, dead piglets were registered daily each morning. The cumulative live-born mortality at day 3, day 7 and day 21 were calculated and will be further referred to as mortality till day 3, day 7 and day 21. All piglets were individually weighed immediately after birth, 24 h after birth of the first live born littermate and at the day of weaning. Considering the variation in weaning age, weaning weight was adjusted to an average weaning age of 21 days by Eqs. (1) and (2) (Douglas et al., 2013). Daily weight gain was calculated based on the adjusted weaning weight in order to adjust also daily weight gain for a weaning age of 21 days. The adjusted weaning weight and daily weight gain were used for analysis and will be further referred to as weaning weight and daily weight gain. Colostrum intake was calculated by the mechanistic model as described by Theil et al. (2014a). The model is based on 24-h weight gain (WG, g), body weight at birth ($BW_b$, kg), and duration of colostrum intake (*D*, min). The equation is the

**Table 1**
Type, content and percentage of fatty acids in the energy supplement Vigorol® (Ecuphar, Oostkamp, Belgium) used to investigate the effect of energy supplementation to neonatal (very) low birth weight piglets on mortality, weaning weight, daily weight gain and colostrum intake.

| **Fatty acid** | Quantity per 1000 ml Vigorol®, g | % of total fatty acids |
|---|---|---|
| Caproic acid (C6:0) | 8 | 1 |
| Caprylic acid (C8:0) | 264 | 29 |
| Capric acid (C10:0) | 176 | 19 |
| Lauric acid (C12:0) | 200 | 22 |
| Myristic acid (C14:0) | 76 | 8 |
| Palmitic acid (C16:0) | 44 | 5 |
| Oleic acid (C18:1) | 56 | 6 |
| Linoleic acid (C18:2) | 74 | 8 |
| Linolenic acid (C18:3) | 10 | 1 |