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New Views on the Importance of Colostrum Consumption by Piglets: Effects on Future Growth and Reproduction

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INTRODUCTION

Colostrum is the first milk secreted by a sow during lactation and is produced for just 24 hours following the onset of farrowing. The substance is rich in energy, and contains *antibodies* and *immunoglobulins* required by the piglet to fight disease and infection. At birth, energy reserves in piglets are very low and the immune system is extremely immature. Colostrum provides energy and the *passive immunity* critical for survival. Newborn piglets require at least 7 ounces of colostrum within the first 24 hours of life (Quesnel *et al.*, 2012) and the ability of the intestine of the piglet to absorb colostrum-derived antibodies is substantially decreased by 24 to 36 hours post-farrowing. Figure 1 shows the amount of colostrum consumed during the first 24 hours of life by piglets surviving to weaning and by piglets that died during the nursing period. Although these data are not necessarily indicative of a cause and effect relationship, they are consistent with the concept that adequate colostrum consumption is critical for pre-weaning survival in swine.

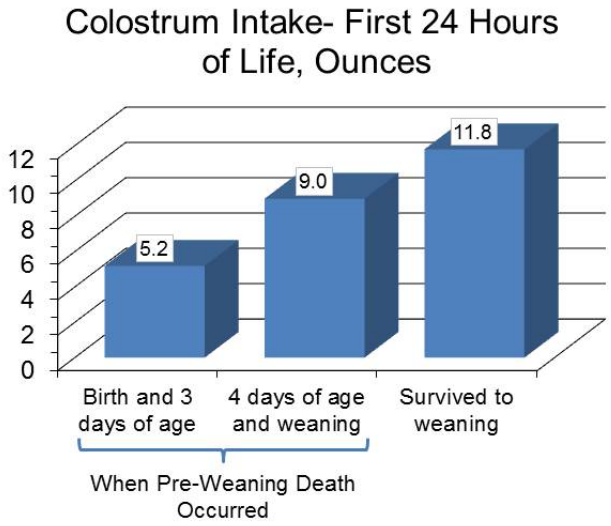

Figure 1. Amount of colostrum ingested by piglets during the first 24 hours of birth that either survived until or died prior to weaning at 25 to 31 days (adapted from Devillers et al., 2011).

Along with newborn piglet nutrition and immunity, recent research has demonstrated that colostrum also affects the development of various piglet tissues including the lining of the digestive tract (Hammon *et al.*, 2012) and the reproductive organs (Bartol *et al.*, 2013). Thus, it has been proposed that the

amount of colostrum consumed by a piglet shortly after birth not only determines pre-weaning survival, but may also have profound effects on future growth and reproduction. Support for this hypothesis was provided in a scientific report published in the June issue of the *Journal of Animal Science* by Vallet *et al*. (2015). That research is summarized herein.

COLOSTRUM CONSUMED ON DAY 1 OF LIFE AND SUBSEQUENT GROWTH AND REPRODUCTION IN GILTS

Vallet *et al.* (2013) developed a simple, rapid and inexpensive method for measuring immunoglobulin in piglet blood serum called the "*immunoglobulin immunocrit*" that allows determination of whether sufficient colostrum has been ingested. For this technique, blood is collected from the piglet jugular vein. The blood is allowed to clot and is then centrifuged. A subsample of the harvested serum is then mixed with ammonium sulfate which precipitates immunoglobulin. The precipitated sample is then loaded into a hematocrit centrifuge tube and centrifuged. The ratio of the length of the precipitate in the bottom of the tube divided by the length of the diluted serum in the tube provides the immunocrit, a ratio for quantitatively assessing the immunoglobulin in the sample (Figure 2).

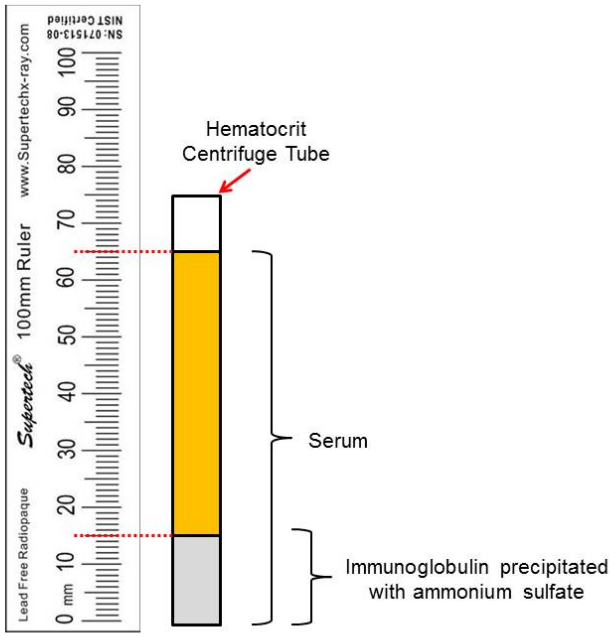

Figure 1. The immunoglobulin hematocrit for determining the amount of immunoglobulin in blood serum of piglets (Vallet et al., 2013). Serum is harvested after the blood sample is centrifuged. A subsample of serum is then mixed with ammonium sulfate to precipitate the immunoglobulin. The precipitated sample is then loaded into a hematocrit centrifuge tube and centrifuged. The immunocrit ratio is determined by dividing the length of the precipitated immunoglobulin at the bottom of the tube by the length of the serum. In this example the immunocrit, which indicates the amount of colostrum consumed by the piglet, is 0.23 (15 divided by 65).

Vallet *et al.* (2015) recently conducted an experiment to assess relationships between Day 1 piglet immunocrit measures and subsequent growth, age at puberty, puberty failure, litter size, and lactation

performance for piglets born at the U.S. Meat Animal Research Center (**MARC**) from 2009 to 2013. Piglets resulted from systematic crossbreeding of Landrace, Duroc, and Yorkshire animals.

The immunoglobulin immunocrit ratio was determined for piglets on Day 1 as described above. Subsequent piglet management was consistent with commercial conditions: cross-fostering of piglets occurred if litters had greater than 12 born live; boar piglets were castrated at 1 week of age; piglets received creep feed beginning on Day 15 of age and were weaned on Day 21 (2009 and 2010) or Day 24 (2011 to 2013) of age; Weaned pigs were moved to a nursery where they stayed for 4 weeks and were then relocated to a grower-finisher barn; and, at 160 to 170 days of age, gilts retained for breeding were transferred to a breeding barn. Gilts entering the breeding area were observed for estrus once daily using fence line contact with mature boars and were mated on second or third estrus using artificial insemination. Females remained on the study for up to 4 parities.

Immunocrit values and body weight measurements at various times from weaning to 200 days of age were available for 15,324 piglets (7,684 boars and 7,640 gilts) farrowed at the MARC between 2009 and 2013. **The data indicated that a low immunocrit on Day 1 of life was associated ($P < 0.01$) with a significantly reduced growth rate through 200 days of age in both sexes**.

Reproductive traits in gilts were positively associated ($P < 0.05$) with immunocrit on Day 1 of life. **In other words, the greater the immunocrit on Day 1 of life, the greater was the reproductive performance as an adult.** Shown in Table 1 are various reproductive characteristics for gilts with the lowest and highest immunocrits, as well as for gilts with an intermediate value. The number of observations for the high, intermediate and low groups was 36, 1,627, and 66, respectively, for age at puberty; 15, 922, and 39, respectively, for piglets born live; 4, 419, and 12, respectively for litter average hematocrit; and, 14, 912, and 33, respectively, for litter average pre-weaning growth rate.

Table 1. Reproductive characteristics in gilts that had high, intermediate, or low immunoglobulin immunocrits on Day 1 of life (adapted from Vallet et al., 2015).

	Immunocrit Level			
Item:	**High**	**Intermediate**	**Low**	**Difference[2]**
Age at puberty, days	196.8	199.9	205.1	8.3
Piglets born live[1]	11.14	10.63	9.77	1.37
Litter average immunocrit[1]	0.1387	0.1340	0.1261	0.0126
Litter average pre-weaning growth rate, pounds/day[1]	0.60	0.59	0.56	0.04

[1]Average for parities 1 through 4.
[2]Difference between high and low.

DISCUSSION AND IMPLICATIONS

The importance of piglets receiving colostrum shortly after birth for survival and good pre-weaning growth has been well-documented. The research summarized herein indicates that the amount of colostrum obtained by neonatal piglets, as measured by the immunoglobulin immunocrit, also influences growth in barrows and gilts to 200 days of age, and reproduction in gilts once adulthood is reached.

The amount of colostrum consumed on Day 1 of life had long-term consequences on growth rate of both male and female piglets. This is probably related to the effects of colostrum ingestion on development of the intestine (Wang and Xu, 1996). Colostrum increases the height of intestinal villi, which are small, finger-like projections that protrude from the lining of the intestinal wall, that are critical for absorption of nutrients. Consumption of colostrum also promotes expression of various digestive enzymes, for example lactase, which breaks down milk.

Ingestion of colostrum reduced subsequent age at puberty by approximately 8 days over the range of immunocrits observed. Slow growing gilts reach puberty later than do gilts exhibiting fast growth rates (Kummer *et al.*, 2009). Whether earlier sexual maturation in this study is due to direct effects of colostrum or a consequence of effects of colostrum on growth is not known.

A central premise of the "*lactocrine hypothesis*" is that hormones found in colostrum such as *relaxin* affect development of the reproductive organs and the mammary glands (Bartol *et al.*, 2013). Consistent with this concept, in the study summarized here, ingestion of colostrum was associated with an increase in litter size of more than 1 piglet over the range of immunocrit values observed. Additionally, litter average immunocrits were increased by approximately 10% and litter average pre-weaning growth rates by approximately 6%.

From a practical standpoint, light birthweights, birth during the latter half of farrowing, large litter size, and prolonged or delayed farrowing decreases colostrum intake by a significant proportion of pigs. Various techniques exist for pig farmers to insure that adequate colostrum is consumed by piglets (Wiegert *et al.*, 2015):

- ✓ **Piglet cross-fostering** is beneficial for sows whose litter size exceeds the number of functional (in other words, good milking) teats, and is accomplished by transferring piglets from sows with large litters to sows with smaller litters.

- ✓ **Split suckling** is used to increase piglet access to colostrum and is accomplished by temporarily removing one-half of the litter from the sow and allowing remaining piglets to suckle unimpeded. This reduces competition and provides greater access to teats.

- ✓ **Bottle feeding** of piglets can be done, but is difficult and often unsuccessful. Moreover, providing commercially available sow milk replacer or a colostrum *supplement* may satiate hungry pigs, but is not a completely effective replacement for colostrum.

Finally, the immunoglobulin immunocrit described by Vallet *et al.* (2013), is an effective tool for determining whether piglets obtain sufficient colostrum and are thus more likely to perform optimally as adults. This is particularly important for animals destined for the breeding herd.

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