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Chapter

Colostrum and Milk in Sow

Morakot Nuntapaitoon

Abstract

Both colostrum and milk quality and quantity can influence piglet survival and growth, especially in a highly prolific sow. The Danish Landrace × Yorkshire crossbred was selected for high prolificacy and challenged to provide enough colostrum and milk of high quality to all piglets. This chapter reviewed the mechanism of colostrum and milk production, basic information of colostrum, and milk quality (immunoglobulin, fat, protein, lactose, etc.) and quantity. The importance of colostrum and milk in modern sows on piglet performance and survival was addressed. Since the sow immunoglobulin cannot pass epitheliochorial placenta in the sow to the piglet's bloodstream. Therefore, colostrum is a crucial role in piglet survival and growth. However, the amount of colostrum and milk production in hyperprolific sow still improve from high litter size. The knowledge about the factors influencing colostrum and milk quality and quantity, such as parity number, piglet, the environment in hyperprolific sows, may support veterinarians and farmers in the commercial swine farms for increasing pig production. Moreover, the technique to improve colostrum and milk quality and quantity were explained, such as feed supplementation in gestating and lactating sows.

Keywords: colostrum, milk, quality, quality, sow, how

1. Introduction

Colostrum and milk are important sources of energy in newborn and pre-weaning piglets. Milk secretion in sow was classified into three parts, including colostrum, transient milk and mature milk depending on composition in each period. Colostrum is the first secretion after farrowing until 24 hours after the first piglet is born [1]. Colostrum plays an important role in the survival and growth of piglets [2]. Colostrum composition includes nutrient, growth factors, hormone, and immune cells that relate to thermoregulation, growth, and contributing to intestinal development and glucose regulation. The transitional milk is a secretion from 34 hours after birth to day 4 of lactation, which was a high-fat concentration [3]. Mature milk is released during day 10 of lactation until weaning because milk composition is relatively stable [4]. Therefore, transition milk and mature milk play in the piglet's growth and related both pre and post weaning performances. This chapter illustrates the importance, production, and composition of colostrum and milk in sow and their factors.

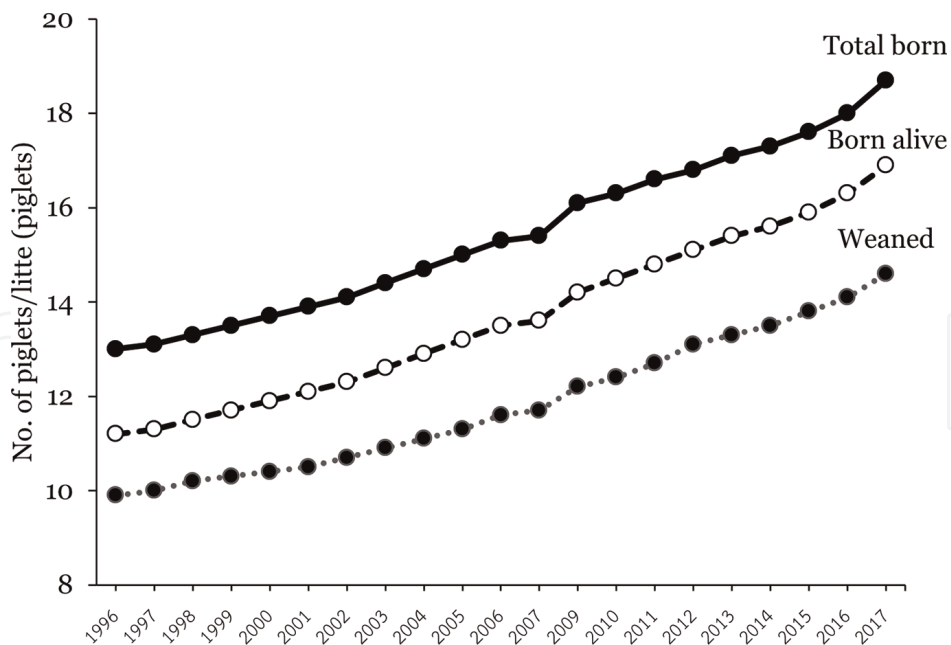


Figure 1.

Progress of the swine genetic improvement in Denmark during 1996–2017 total number of piglets per litter (Total number of piglets per litter: total born; number of born alive piglets per litter: Born alive; number of weaned piglets per litter: Weaned (modified from Observatori del porcí [6] and Hansen [7]).

2. The important role of colostrum and milk

Colostrum and milk play an important role in piglet survival and growth during the lactation period. In the last decade, goal of genetic improvement in swine is to increase the total number of piglets per litter [5]. The total number of piglets per litter in Denmark in 1996–2017 rapidly increased from 13.0 to 18.7 piglet/litter or increasing 5.7 piglets/litter over the past 21 years (**Figure 1**). On the other hand, 50–80% of piglet mortality occurs during the first week after farrowing, especially in the first 72 hours of life [8–10]. In general, newborn piglets have glycogen storage in the liver and muscle for maintenance of the body, temperature, and energy for movement to consume colostrum after birth [11]. The glycogen rapidly declined within 12 to 17 h after birth when piglets have low colostrum consumption [12]. Therefore, it has been demonstrated that early mortality is mainly since a low colostrum consumption [13]. Furthermore, the relationship among colostrum consumption, mortality, and growth at weaning was reported in the previous study. Piglets consumed colostrum less than 400 g had a lower average daily gain than piglets consumed colostrum more than 400 g by 43 gram/day and higher mortality by 10 times [2].

Milk is a nutrient that most affected piglet growth during the suckling period. Milk supplementation in piglets improved growth performance that was reported in many studies [14, 15]. However, most of hyperprolific sows are low milk production, especially in tropical climates [4, 16]. Therefore, management to improve milk production in the lactation period should be concerned in commercial swine farms.

3. Mechanism of colostrum and milk production

Colostrum and milk were produced from the mammary gland of the sows that were developed from the embryo until entry to puberty and gestation. The mammary gland between birth and puberty was isometric growth and rapidly developing called

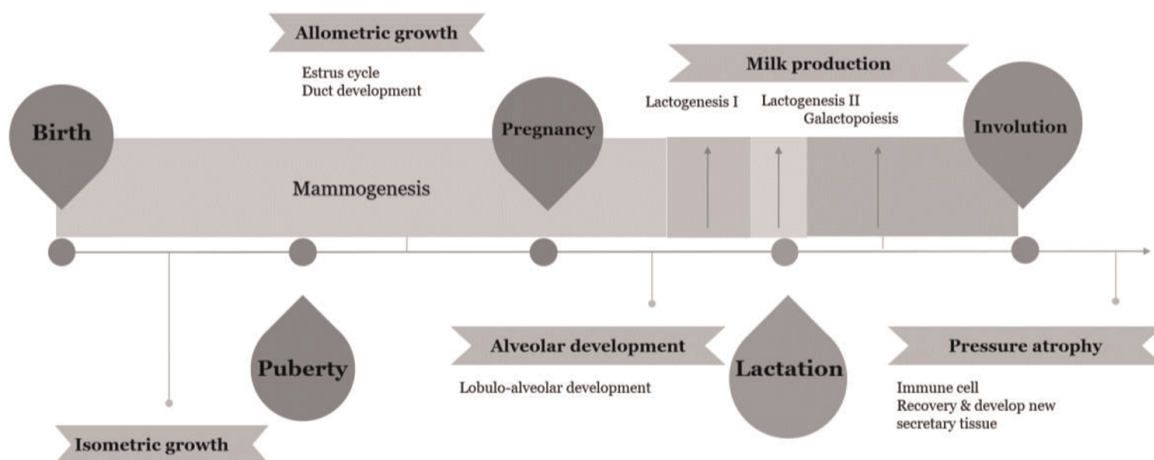


Figure 2.
 Mammary gland development from birth until weaning.

“allometric growth” after the onset of puberty, gestation, and lactation (Figure 2). The mammary gland between puberty and pregnancy was provided by hormones for complete development, for example, growth hormone, prolactin, and estrogen.

In the mid of gestation, the mammary gland developed called “Lactogenesis I,” which mainly developed duct and mammary gland by IGF-1 stimulation. The IGF-1 stimulates cortisol hormone from the adrenal gland and prolactin hormone from the placenta for inducing milk production. Completed alveolar development in the sows takes place during the last trimester of gestation called “Lactogenesis II” [17]. Prolactin induced lactoalbumin for producing lactose synthetase enzymes that were used for colostrum production. Colostrum was started to produced and help in the parenchyma tissue. Almost all colostrum is produced before the piglet is born and is independent of the suckling piglet activities [18]. However, the last week of gestation is crucial for colostrum production.

Most of the colostrum is secreted during the first 12 to 16 h after the onset of farrowing and decreases after 16 h onwards. Transient milk begins to produce during 24–34 h after the onset of farrowing within Lactogenesis II. The colostrum slowly changed to transient milk in this period. The stage of Lactogenesis II was finished within 1–2 days after farrowing. The transient milk slowly changed to mature milk on day 10 of lactation. After the colostrum period, milk secretion depended on the piglet’s suckling activities to maintain milk secretion until weaning called “galactopoiesis.” Galactokinesis or milk ejection is the active transfer of milk from the parenchyma to teats by suckling or other sensory activation (auditory, tactile, and visual). All activation stimulates oxytocin from the hypothalamus. Oxytocin is secreted into the blood and to the myoepithelial cell within the mammary gland leading to milk injection.

4. Calculation of colostrum and milk yields

The colostrum and milk yields represent the amount of colostrum and milk that were removed by piglets in the litter. Because yield was calculated from the sum of colostrum/milk intake of piglets. At present, there is no direct method to quantify both colostrum and milk yields.

Colostrum and milk yields measurement can be calculated from the indirect method, for example, the weigh-suckle-weigh method and predicted equations [Devillers et al. [19]; Theil et al. [20, 21]; Hansen et al. [22]. See below.

4.1 Devillers et al.

Colostrum consumption (g) = $-217.4 + 0.217 t + 1,861,019 BW_{24}/t + BW_B$
 (54.80–1,861,019/t) ($0.9985-3.7 \cdot 10^{-4} tfs + 6.1 \cdot 10^{-7} tfs^2$).

4.2 Theil et al.

Colostrum consumption (g) = $106 + 2.26 WG + 200 BW_B + 0.111 D - 1414 WG/D + 0.0182 WG/ BW_B$.

where t or D is time (min) elapsed between the 1st and 2nd weighting (which defines duration of colostrum consumption).

BW₂₄ is body weight at 24 h (kg).

BW_B is birth weight (kg).

Tfs is the interval between birth and the first suckling (min).

WG is body weight gain between the 1st and 2nd weighting (g).

The predicted colostrum equation by Devillers et al. [19] was measured using bottle-fed-piglets but by Theil et al. [20] was measured using the deuterated water dilution technique. The previous study demonstrated that the predicted colostrum equation by Devillers et al. [19] was 43% lower than by Theil et al. [20] [3]. In line with this, according to the formula by Devillers et al. [19], a previous study demonstrated that piglets with the colostrum less than 200 g or 180 g/kg of birth weight have a high chance of mortality [1]. The piglets should be consuming 250 g of colostrum for survival and high growth performance, whereas Nuntapaitoon et al. [2] recommended that 200–400 g of colostrum should be provided in all piglets for decreasing mortality based on the formula by Theil et al. (Figure 3) [20].

Milk yield was also estimated by using the deuterated water dilution technique [21] and summarized data from many previous studies for generating predicted equation [22, 23]. For the latest equation, litter size and weight gain have to be included in the formula.

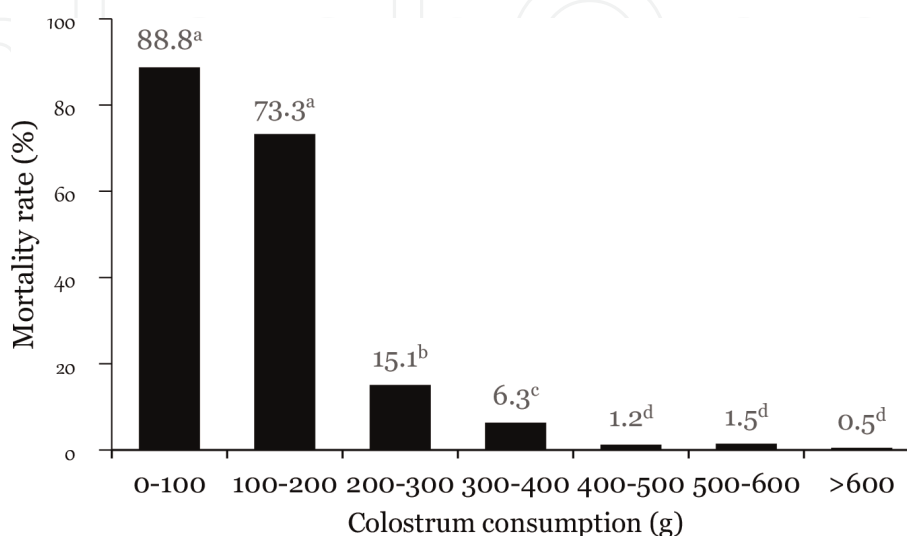


Figure 3. Influence of colostrum consumption (g) on preweaning mortality in a commercial swine herd in a tropical climate calculated by Theil et al. [20]. Different superscript letters indicate significant differences ($P < 0.05$) [2].

5. Colostrum and milk yields

Amount of colostrum and milk yields were reported in many studies. The colostrum yield ranged 1.7–10.5 kg, and the colostrum consumption was 426 g piglet under tropical climate [2, 4, 24, 25]. The frequency distribution of individual colostrum consumption and colostrum yield in a commercial swine herd in Thailand was presented in **Figures 4** and 5. On the other hand, range colostrum yield was 3.3–6.0 kg [4, 26–28].

Colostrum continuously releases during the colostrum period. On the other hand, milk is released every 30–50 min and spends time 10–15 sec [29]. In general, milk yield in the first 4 days means 8 kg/day and the peak of lactation at 17 days was 15 kg/day [22, 23]. The milk yield ranged 3.9–17.2 kg/day in Danish Landrace × Yorkshire crossbred sows reared in a commercial swine herd in Thailand. The frequency distribution of milk yield is presented in **Figure 6**. On the other hand, the range of milk yield was 5–15 kg/day [3, 30]. In line with this, colostrum and milk production in sows

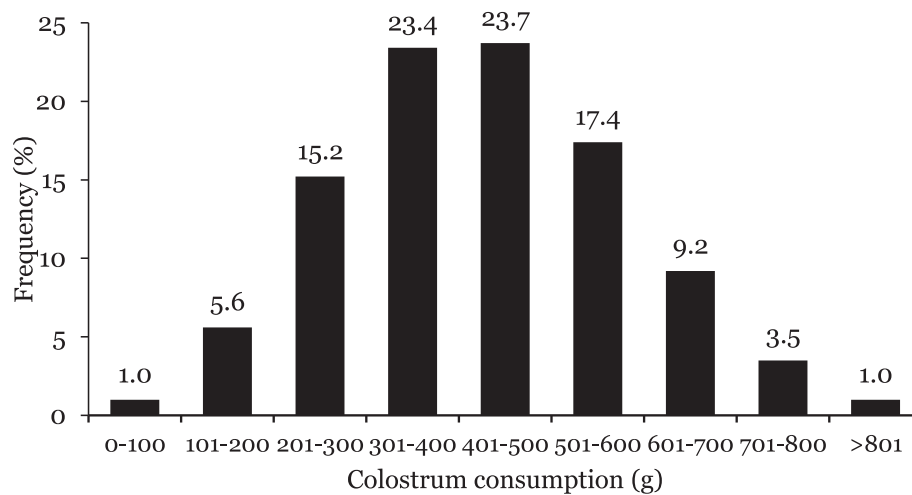


Figure 4. Frequency distribution of individual colostrum consumption (g) in a commercial swine herd in Thailand [2].

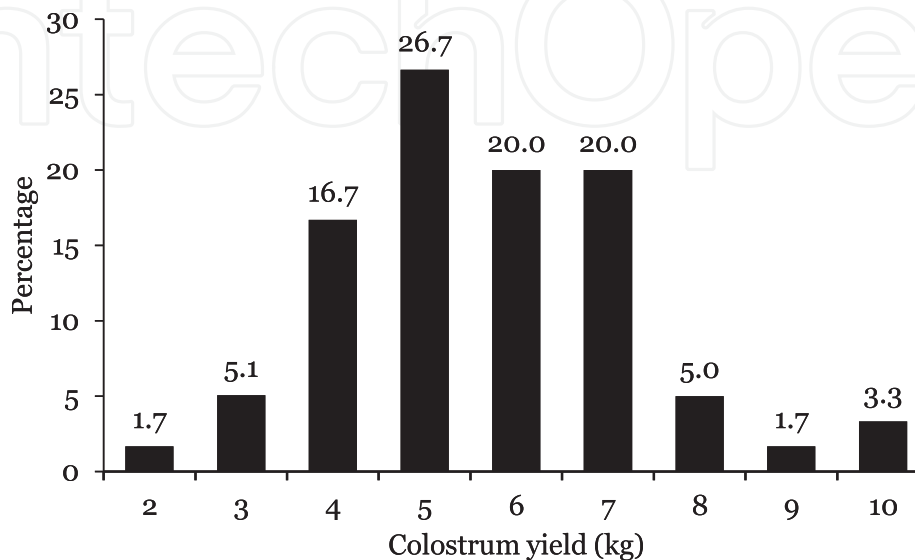
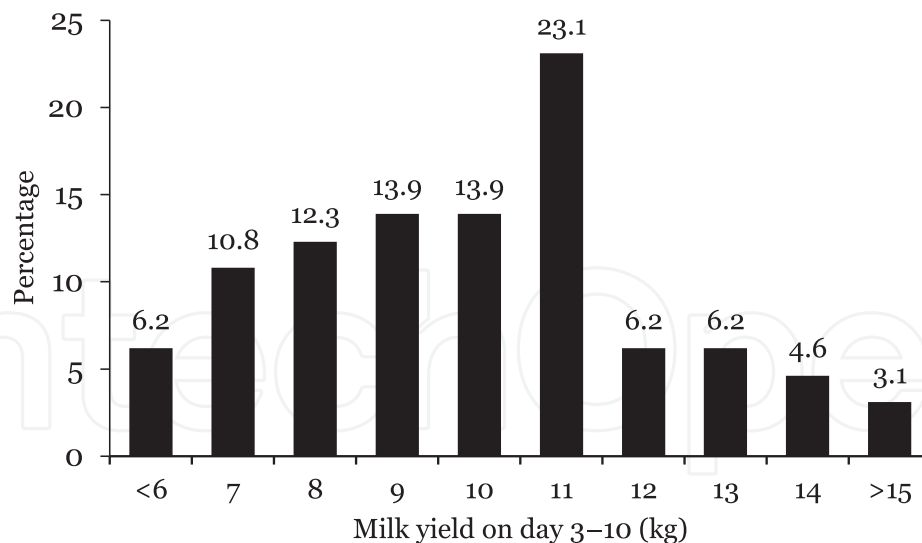
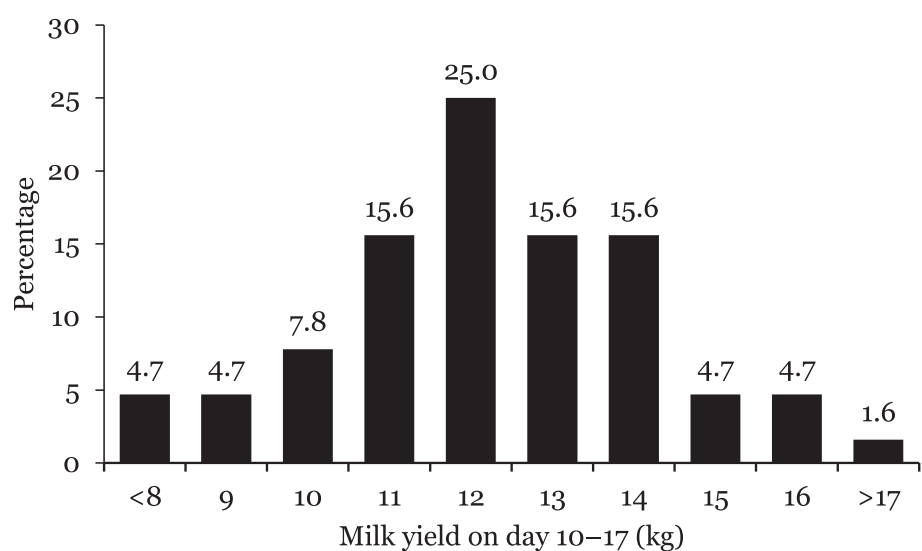


Figure 5. Frequency distribution of individual colostrum yield (kg) in a commercial swine herd in Thailand [4].



(a)



(b)

Figure 6. Frequency distribution of (a) milk yield on days 3-10 and (b) days 10-17 of lactation from 105 Danish landrace × Yorkshire crossbred sows reared in a commercial swine herd in Thailand [4].

are highly variable due to differences in breed, nutrition, sows, litter and farrowing characteristics, hormonal status, and environmental factors [20, 28, 31, 32]. The high temperatures in tropical climates may result in decreased blood supply to the mammary epithelium that produces colostrum and milk and increased stress in the sows. Knowledge regarding the impact of temperature on mammary blood flow and colostrum and milk production is currently lacking.

6. Colostrum and milk composition

The main compositions of colostrum and milk include fat, protein, lactose, vitamin, mineral, and dry matter. Moreover, bioactive molecules, such as immunoglobulins, growth factors, and enzymes, are also included in milk secretion. It is important for the survival of the newborn piglet and the proper development of organs, such as

Composition	Days in milk							
	0		3		10		17	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Lactose, g/100 g	2.8	1.7–5.0	4.3	2.1–5.3	4.8	2.1–5.5	4.9	2.4–5.6
Fat, g/100 g	4.9	2.5–7.5	7.1	4.0–14.2	6.1	2.3–10.9	6.1	3.9–8.7
Protein, g/100 g	15.3	5.2–22.3	7.2	3.7–16.7	5.7	3.8–16.7	5.9	3.7–18.5
DM, g/100 g	23.6	16.4–29.1	20.1	15.6–26.9	18.3	16.2–25.3	18.9	16.3–28.7

Nuntapaitoon et al. [4].

Table 1.
 Colostrum and milk in Danish landrace × Yorkshire crossbred sows reared in a commercial swine herd in Thailand.

the gastrointestinal tract and brain. The main compositions of colostrum differ from milk (Table 1).

The chemical composition of colostrum (day 0), transition milk (day 3), and mature milk (day 10 and 17) is very different in hyperprolific sow. Lactose concentration gradually increases from 2.8 g/100 g in colostrum to 4.3 g/100 g in transition milk and 4.9 g/100 g in milk. Lactose is the main energy source for piglets throughout the lactation period. Moreover, lactose is rapidly absorbed and is related to the yield because of the structure and major osmotic characteristics of colostrum and milk [33].

Lipids were lowest in the colostrum period (4.9 g/100 g). It rapidly increases in the transition period (7.1 g/100 g) and is stable in mature milk (6.1 g/100 g). Fat also plays an important role to provide energy, increase metabolism, and protect the newborn against microbial infections. Many studies have analyzed fatty acids in various biological samples, such as plasma, milk, urine, and tissue samples, using a variety of analytical strategies. Analytical tools including gas-chromatography mass spectrometry (GC-MS), gas-chromatography with flame ionization detection (GC-FID), and liquid chromatography-mass spectrometry (LC-MS) have been used to perform fatty acid analyses [34]. The data from our team, a total of 31 free fatty acids in colostrum and milk of hyperprolific sows reared in a tropical climate, was presented in Table 2 (unpublish data). It was found that free fatty acids in colostrum and milk are very different.

The most important in colostrum is immunity. Immunoglobulins as protein components in colostrum are important for piglets to prevent disease and reduce mortality. Colostrum contains six times immunoglobulins (IgA, IgG, and IgM) compared with milk. The concentration of IgG is rapidly declined by nearly 30% within 6 h after birth [35, 36] (Figure 7), while IgA slightly decrease. IgA is important for the protection of the gastrointestinal tract and plays a key role in preventing early diarrhea. The neonatal piglets have high morbidity from *Escherichia coli* and *Clostridium perfringens* infection [37] and lead to death in the first weeks of farrowing.

7. Factor influencing colostrum and milk yields and composition

Nutritional status in the gestation period highly influences colostrum and milk production in sows [3, 38]. Mammogenesis is started at 85–109 days of gestation [39].

Composition	Day		
	0	3	17
<i>Fatty acid</i>			
Caprylic acid	0.006 ^c	0.012 ^b	0.033 ^a
Capric acid	0.062 ^b	0.059 ^b	0.207 ^a
Lauric acid	1.2 ^b	1.5 ^b	3.1 ^a
Myristic acid	4.5 ^b	3.7 ^c	5.8 ^a
Myristoleic acid	0.025 ^c	0.100 ^b	0.287 ^a
Pentadecylic acid	0.117	0.099	0.095
Palmitic acid	21.4 ^b	21.2 ^b	25.8 ^a
Palmitoleic acid	1.7 ^a	1.8 ^a	0.6 ^b
Margaric acid	0.262 ^a	0.257 ^a	0.200 ^b
Cis-10-heptadecaric acid	0.115 ^c	0.190 ^a	0.157 ^b
Stearic acid	6.5 ^b	8.4 ^a	5.9 ^b
Elaidic acid	0.232 ^a	0.170 ^b	0.174 ^b
Oleic acid	32.0 ^c	37.6 ^a	34.2 ^b
Linolelaidic acid	0.145 ^a	0.160 ^a	0.101 ^b
Linoleic acid	25.8 ^a	19.0 ^b	18.8 ^b
Arachidic acid	0.157 ^b	0.189 ^a	0.194 ^a
Gamma-Linoleic acid	0.239 ^b	0.640 ^a	0.192 ^b
Paullinic	0.324 ^b	0.634 ^a	0.516 ^a
Linolenic acid	1.8 ^a	1.3 ^b	1.4 ^b
Eicosadienoic acid	0.565 ^a	0.628 ^a	0.402 ^b
Behenic acid	0.049	0.047	0.060
Dihomo- γ -linolenic acid	0.316	0.272	0.189
Erucic acid	0.062 ^b	0.083 ^a	0.082 ^a
Eicosatrienoic acid	0.176	0.114	0.088
Arachidonic acid	1.2 ^a	1.0 ^b	0.9 ^b
Cis-13,16-docosadienoic acid	0.008	0.001	0.004
Lignoceric acid	0.179 ^a	0.108 ^b	0.097 ^b
Docosatetraenoic acid	0.270 ^a	0.205 ^{ab}	0.187 ^b
Docosapentaenoic acid	0.392	0.301	0.314
Eicosapentaenoic Acid	0.009	0.010	0.003
Docosahexaenoic acid	0.013	0.013	0.021

a, b, c Different superscript letters within rows indicate significant differences (P < 0.05).

Table 2.
The macrochemical composition and fatty acid profile in colostrum (day 0) and milk (day 3 and 17 of lactation).

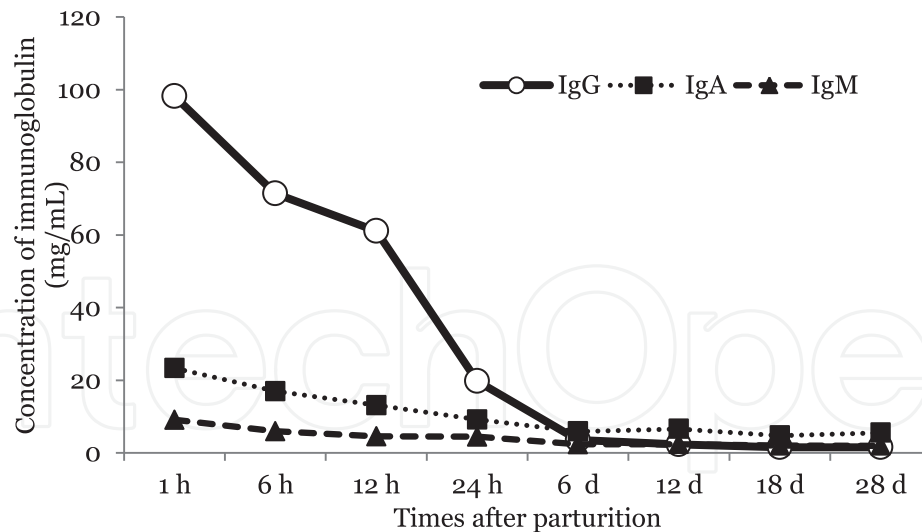


Figure 7.
The immunoglobulin concentration in sow colostrum throughout lactation period [35].

In this time, sow required more energy for developing mammary gland and also increase insulin resistance, especially in fat sows [40]. High insulin resistance presents high glucose level that passes through the mammary gland, leading to increased colostrum production. Many previous studies found that backfat thickness during late gestation influenced colostrum and milk production [24, 26]. They found that low-backfat thickness sows at 109 days of gestation had low milk production. The regression analyses revealed that an increase of backfat thickness by 1.0 mm at day 109 of gestation resulted in an increased milk yield of sows between 3 and 10 days of 271 g per day [24]. Recently, body weight at birth, cumulative birth interval, and litter size were significant risk factors affecting piglet colostrum consumption [41]. Furthermore, Nuntapaitoon et al. [4] found that sow parity number 2–4 had a higher colostrum yield than sow parity number 1 (Table 3).

The litter size increased milk production for stimulating the mammary gland by piglet [42]. Figure 8 illustrated that high litter size is positively associated with milk production. However, high litter size declined individual colostrum consumption. In addition, piglet factors are also related to colostrum consumption [2, 41, 43]. They found that high piglet birth weight has high colostrum consumption and high suckling performance that stimulate milk production, especially in the first 3 days of lactation [44].

Sow parity number is the main association between production and composition. Multiparous sows have higher milk production than primiparous sows [4, 45]. The sow parity number 2–4 had the highest milk production and increased from first parity by 35% [45]. In contrast, Nuntapaitoon et al. [4] found that no evidence of parity differences was observed on milk yield.

Sow parity number has negatively correlated with fatty acid profiles in colostrum, which refers to metabolic status in sows [46]. The PLS-DA in Figure 9a shows the influence of parity number on the overall fatty acid profiles of colostrum. It has been demonstrated that significant dynamics in the fatty acid compositions of sow colostrum are in association with parity number. Moreover, high relative abundances of palmitic acid, eicosatrienoic acid, cis-10-heptadecanoic acid, capric acid, lignoceric

Composition	Parity			SEM [*]	P-value
	1	2-4	5-6		
Colostrum yield, kg	5.4 ^b	7.0 ^a	5.9 ^b	0.4	0.004
Fat, g/100 g	5.2	4.9	4.6	0.2	0.164
Protein, g/100 g	15.4	15.2	15.2	0.9	0.979
Lactose, g/100 g	2.6	2.9	2.9	0.2	0.453
Dry matter, g/100 g	23.8	23.5	23.3	0.7	0.853

^{a, b} Different superscript letters within rows indicate significant differences ($P < 0.05$).
^{*}Greatest standard error of the mean (SEM).
Nuntapaitoon et al. [4].

Table 3.
Effect of parity on colostrum yield and chemical composition of colostrum in Danish landrace × Yorkshire crossbred sows.

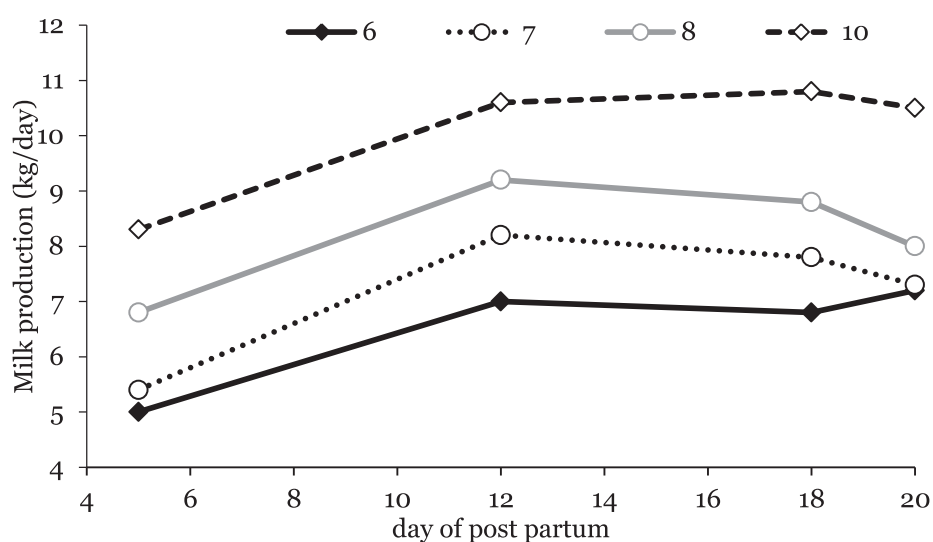


Figure 8.
Sow milk production in different litter sizes (modified by [42]).

acid, and lauric acid were accountable for the discrimination of colostrum from sows with higher parity numbers (**Figure 9b**). The high level of fatty acid profile in sow colostrum is related to the negative energy balance of sows. The stearic acid and palmitic acid have been related to negative energy balance periods, as animals mobilize adipose tissue for energy and related with colostrum production [47, 48], as in primiparous sows.

The concentration of immunoglobulin in colostrum depends on the management, the physiology of the mammary gland, parity, vaccination, and nutritional status [20, 28, 49]. In tropical climates, the variation of immunoglobulin concentration in the sow colostrum was influenced by their parity number and housing conditions [36]. The concentration of IgG in primiparous sows was lower than that in multiparous sows. Moreover, sow reared in a conventional open-housing system had a higher colostrum IgG concentration than in an evaporative cooling-housing system. On the other hand, Zhao et al. [50] reported housing conditions did not relate to IgG concentration in colostrum. Therefore, factors influencing colostrum IgG concentration should be investigated in further study.

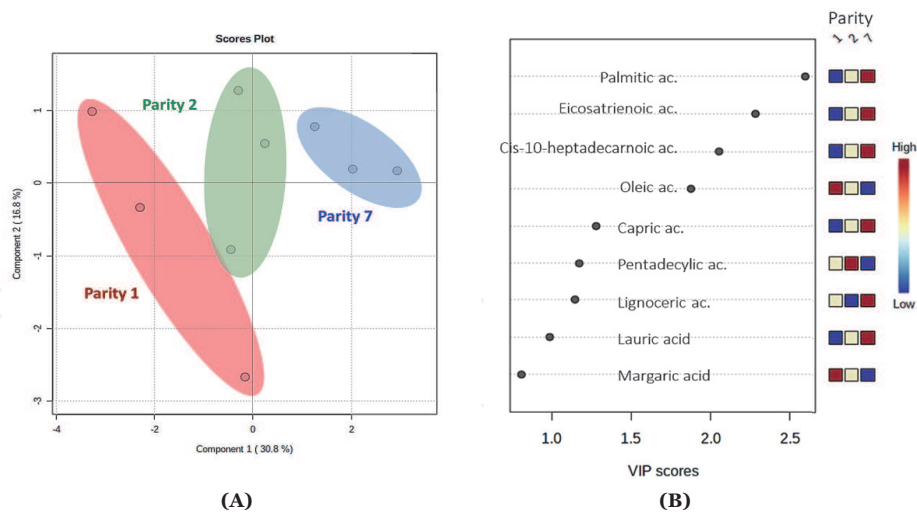


Figure 9. PLS-DA score plot for an overall comparison of fatty acid profiles among representative colostrum samples from sows with parity number 1 (red), 2–6 (green), and ≥ 7 (blue) (panel A). VIP scores higher than 1.0 indicate potential biomarker fatty acids accountable for the discrimination among colostrum samples from different parity numbers (panel B) [46].

8. Technique for increasing colostrum and milk yield

The increasing feed intake and appetite in late gestating and lactating sow enhanced colostrum and milk production. Sow fed ad libitum in 7 days postpartum has higher milk production than in before farrowing [51]. Moreover, sow with appropriate condition before farrowing and peak of lactation related colostrum and milk production [18]. Therefore, many studies revealed the effect of feed additive and nutritional supplementation on colostrum and milk production many years ago. Protein supplementation in late-gestating sows improved colostrum production [52, 53]. They demonstrated that fermented potatoes protein increased colostrum yield, individual colostrum consumption in primiparous sows, and piglet birth weight and weight during the suckling in all sows period. It is illustrated that primiparous sows must be improved feed intake for colostrum production and fetal growth in the late gestation period. Increasing dietary protein at 135 g/day during lactation increased milk yield and milk protein concentration [54, 55].

Dietary fatty acid from different sources increases the amount of colostrum. Conjugated linoleic acids supplementation in late-gestating sow until farrowing increase +60 g of individual colostrum consumption [56]. Moreover, Flummer and Theil [57] found that supplementation of leucine increased colostrum consumption, increased growth rate, and decreased piglet mortality.

Fiber supplementation in late-gestating sow enhanced serum short-chain fatty acid in sow [22, 23]. The short-chain fatty acid is the source of milk production [18]. Quesnel et al. [58] reported that sows fed a high fiber diet from day 26 of gestation to farrowing had higher milk production than sows fed a low fiber diet. Loisel et al. [59] reported that fiber supplementation from 92 days of gestation to farrowing had increased colostrum production. However, Krogh et al. [60] compared different sources of fiber and fat during gestation on colostrum yield, that is, sugar beet pulp, alfalfa meal, and a combination of palm fatty acid distillate, soybean oil, and

trioctanoate from day 105 of gestation. Different sources did not affect the colostrum yields of sow.

Generally, prostaglandin F₂α was used for inducing farrowing in pregnancy sow and was also applied after parturition for reducing postpartum discharge and may affect colostrum and milk production. Milk synthesis collaborated hormones during parturition that declined progesterone and increased prolactin, estrogen, and corticosteroids. Luteolytic substance decreased serum progesterone concentration and increased prolactin, estrogen, and corticosteroids within 1 h after injection [33]. High concentration of progesterone declined milk synthesis [61]. Moreover, high progesterone levels in sow at the end of farrowing increase the risk of piglet diarrhea on the first day of life [62]. This is probably because declined colostrum production leads to low colostrum consumption and received low immunity. However, the previous studies demonstrated that farrowing induction did not affect colostrum production [25, 63–65] because colostrum is mostly produced before parturition at 85 days of gestation. On the other hand, recent research by Maneethong et al. [66] and Nuntapaitoon et al. [67] shows that natural prostaglandin F₂α increased colostrum and milk production in the first week of lactation. The injected natural prostaglandin F₂α after farrowing increased the milk yield between day 3 and 10 (**Figure 10**) [67]. In addition, prolonged farrowing duration declined colostrum yields [62]. In general, high litter size in hyperprolific sows increase farrowing duration. Piglet was born in prolonged farrowing time of sow highly chance hypoxia piglets and related colostrum consumption from high uterine contraction during peripartum period leading to decrease blood and oxygen supply to the piglets [4].

Furthermore, lactation management improved milk production. The sensory activation, such as auditory, also increased milk production and growth performance [68, 69]. The sow reared under temperature at 27–32°C has low milk production [70]. Farrowing pen easily assessed to mammary gland increased suckling behavior and milk production [71].

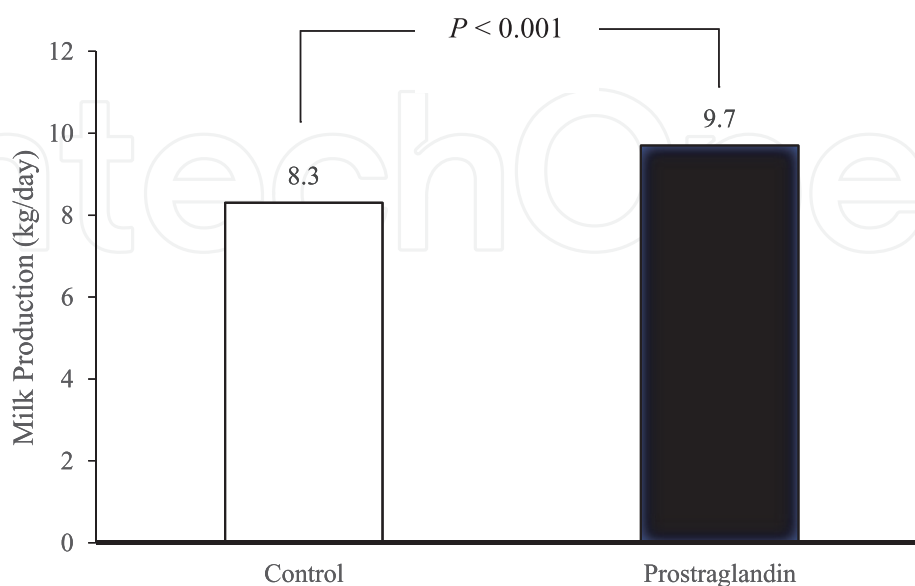


Figure 10. The milk yield between days 3 and 10 in control and prostaglandin F₂α group sows. A significant difference between a group at $P < 0.001$ [67].

9. Technique for increasing colostrum and milk quality

Increasing the fat content in the late gestational diet increase colostrum fat. Kurachon et al. [72] found that protein supplementation in late-gestating sows increased colostrum fat, especially in primiparous sows. Jackson et al. [73] reported that 10% corn oil supplementation during 100 days of gestation until farrowing increases colostrum fat. Moreover, Loisel et al. [59] and Krogh et al. [60] show that fiber supplementation in late gestation until farrowing increased the fat and lactose content of colostrum.

The effect of nutrition on the concentration of immunoglobulin in the colostrum was studied with particular attention to the increase in IgG intake. Dietary supplementation with conjugated linoleic acid in late gestation increased IgG, IgA, and IgM content in colostrum [74]. Moreover, Algae supplementation in sows at 107 days of gestation until weaning increased IgA concentrations and tended to increase IgG in colostrum. The Algae enhance protein and lysozyme in the sow and leading to increasing IgG concentrations in colostrum [75]. L-arginine supplementation in sow diet during late gestation increased immunoglobulin G concentration in colostrum. Nitric oxide synthase stimulates hormones and immune in sow that transfer to mammary tissue [76]. Dietary L-carnitine stimulated sow feed intake [77], and fat supplementation also enhanced milk fat and milk production [78]. Selenium plays an important role in colostrum and milk composition. The benefits of selenium improved vesicular development in mammary tissue [79], immunoglobulin, and antioxidants in colostrum and milk [80, 81].

Moreover, many studies demonstrated that natural prostaglandin F₂α increased IgG concentration in colostrum [66], and increased piglet survival and weaned weight [82–84] and was not negatively associated with sow reproductive performances [25, 64, 82]. However, Foisnet et al. [63] found that IgA concentration in colostrum declined when farrowing was induced by prostaglandin F₂α. Recently, Taechamaeteekul et al. [65] illustrated that altrenogest in combination with double administrations of prostaglandin F₂α did not affect colostrum IgG. The benefits of prostaglandin F₂α have not been clearly elucidated.

10. Conclusions

The quality and quantity of colostrum and milk are crucial for survival and growth in the piglets, especially in high prolific sows. The amount of colostrum and milk production represent sow health and performance in lactation. High immunoglobulin concentration transfers from sow still goals for protecting piglets. Fat and lactose in milk secretion are related to growth performance. The knowledge of improving colostrum and milk production and composition is still lacking. The nutritional strategies to increase piglet survival are the main further research. However, management in the late gestation thought out lactation period (i.e., induce farrowing, vaccination program and environment) also impacts piglet performances in both pre- and post-weaning periods.

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