Lactating sow feeding: optimising sow and litter performance and health

This article focuses on the feeding of hyperprolific sows. Hyperprolific sows in this context are sows with high reproductive performance.

Optimising the productive capacity of hyperprolific sows requires proper attention to sow management and nutrition.

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High output of pigs from a sow unit requires not only consistently large litters, but also high livability of piglets.

	95% confidence interval				Percentile[1]	
	Mean	Lower	Upper	±[1]	10%[2]	90%[3]
Live born per litter	15.64	15.43	15.85	1.4%	12.00 (76.7%)	19.00 (121.5%)
Piglet weight at standardisation (48 hours) (kg)	1.45	1.43	1.46	1.1%	1.15 (79.3%)	1.74 (120%)
Weaned piglets per litter	11.52	11.41	11.63	1.0%	9.00 (78.1%)	13.00 (112.9%)
Daily litter gain (kg)	2.62	2.58	2.65	1.4%	2.01 (76.7%)	3.24 (123.7%)
Sow weight loss during lactation (kg)	19.31	18.15	20.46	6.0%	42.20 (218.5%)	-2.91 (-15.0%)[4]
Sow weight loss during lactation (%)	6.67	6.27	7.08	6.1%	14.27 (214.0%)	-0.95 (-14.3%)[4]

Table 1. Sow performance reference numbers for comparison between farms (Adapted from Christensen and Sørensen, 2013). [1]expressed relative to the mean; [2]10% percentile indicate that 10% has a performance below the stated value; [3]90% percentile indicate that 10% has a performance above the stated value; [4]10% of sows gained weight during lactation.

Causes for loss of piglets

A recent Danish study involving 30 farms investigated causes of suckling piglet mortality. A total of 1,364 dead piglets, sampled one specific week, were analysed for causes of death. Approximately 53% of the investigated piglets were either very underweight (<0.7kg) or underweight. It was also observed that 68% of the piglets had an empty stomach.

70% of the mortality occurred from day 0-4. Farm observations showed that crushing was the most frequently reported cause of death in 73% of the farms, while both nutrition and weak born were the most frequently reported causes of mortality in 27% of the farms.

However, the reported causes of death from the latter set of farms were not aligned with those identified at autopsy. The autopsy of the piglets showed that, in reality, 57% of the farms had nutrition and weak born as the most frequent cause of piglet loss on day 0-4 of life (Fig. 1). This indicates that an inadequate supply of milk leads to death more often than perceived by farm workers and managers.

From day 5 onward, the pattern of causes of mortality changes. Autopsy showed that septicaemia accounted for 31% of the mortality after day four (Fig. 1).

The reason for crushing is often assumed to be related to suboptimal design of the farrowing pen, but an underlying association to nutrition is always under suspicion. Mortality due to septicaemia is associated with tail docking, castration and tooth clipping/grinding.

The pattern of mortality reported here may look different in other regions of the world. However, it is evident that prevention of early pre-weaning mortality is closely related to proper pen design, management and efficient sow milk production. A fast development of the gut functionality and integrity is needed for optimal milk utilisation. This can be obtained with good

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Fig. 1. Causes of pre-weaning mortality day 0-4 and later found by autopsy of 1,364 dead suckling piglets collected over one week from 30 Danish farms (adapted from Frandsen & Haugegaard, SEGES, 2017).

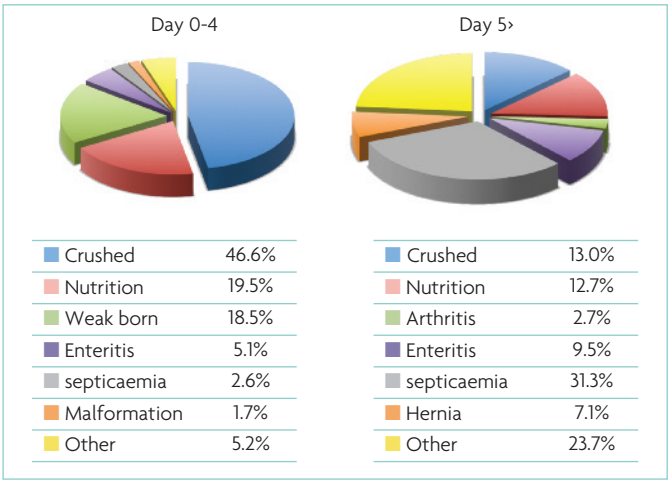
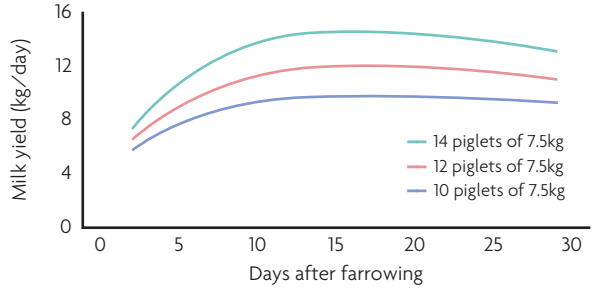


Fig. 2. Estimated daily milk yield with different litter size at weaning and a piglet weaning weight of 7.5kg day 28 (adapted from Bruun, SEGES, 2013).



	Average	Top 25%	Bottom 25%
Alive born/litter	15.9	16.5	15.4
Weaned/litter	13.8	14.6	12.9
Pre-weaning mortality (%)	13.4	11.8	16.0
Weaning weight (kg)	6.8	6.4	7.3
Weaned/sow/year	31.4	33.8	29.1
Litter/sow/year	2.27	2.33	2.20
Non-productive days/litter	13.0	10.3	16.5
Wean to service (days)	5.7	5.5	6.0
Return to oestrus (%)	5.3	3.8	7.2

Table 2. Danish sow performance results 2015. The data comprises annual results from 459 sow units and 340,000 year-sows (adapted from Jessen. SEGES. 2016).

	Amino acid recommendation	
	Denmark[2]	USA
Lysine	100	100
Methionine	32	26
Methionine + cysteine	60	54
Threonine	65	63
Tryptophan	20	20
Isoleucine	56	56
Leucine	115	115
Histidine	39	39
Phenylalanine	55	55
Phenylalanine + tyrosine	113	114
Valine	76	85

Table 3. Amino acid/lysine ratios in Danish and American recommendations for lactating sows. [1]mean of four references; [2]based on ileal digestible amino acids.

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hygiene to ensure a low load of pathogenic bacteria and a balanced microbiota development. Reduction of the pre-weaning mortality mainly calls for focus on correct piglet handling and strategies to prevent enteritis. Thus, it is vital to provide feed supplementation of such a quality that the gut integrity is not challenged and nutrient digestion and utilisation is optimised.

Factors affecting sow performance

Sow milk yield increases with increasing litter size and reaches a peak after 14-17 days of lactation (Fig. 2). The total amount of milk produced to wean 10, 12 or 14 piglets with a mean weaning weight of 7.5kg at day 28 was estimated to be 233kg, 282kg and 341kg milk, respectively. It has been found that litter weight gain increased from 1.7-2.8kg/day when litter size increased from 6-14 piglets. However, daily weight gain of piglets decreased by 81g/day when litter size increased from 6-14 piglets. This shows that sow milk yield per day increases with increasing litter size, but also that the sow milk yield per piglet decreases with increasing litter size.

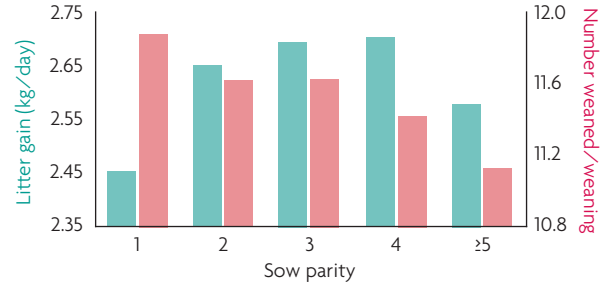
As a rule of thumb it requires four litres of sow milk to generate 1kg piglet weight gain. Litter weight gain is thus a function of litter size and sow milk yield. This highlights the importance of optimal feeding to maximise milk production.

Data from eight Danish farms comprising 871 litters after hyperprolific sows were used to evaluate variation in litter weight gain and sow body weight loss during lactation. The average sow weaned 11.52 piglets, produced 2.62kg litter gain per lactation day and had a body weight loss during lactation of 19.3kg. The lactation length was on average 27.7 days.

Sow parity number influenced sow performance greatly, as illustrated in Fig. 3. The graph shows the decreasing weaned litter size with increasing parity and that the daily litter weight gain reached maximum at parity four. Several other production parameters could have been used to illustrate the impact of parity on performance. Fig. 3. also shows that the performance of parity one sows differs especially from parity two, three and four sows.

Some key sow performance reference values are given in Table 1 together with 95% confidence intervals as well as 10% and 90% percentiles to illustrate the variability.

Fig. 3. Effect of parity on daily litter weight gain (kg) and weaned piglets per weaning (adapted from Christensen and Sørensen, 2013).



The main function of the numbers presented in Table 1 is that the confidence intervals and the percentiles can be used for comparisons between farms or between sow-units. This can identify focus areas for performance improvements on farms or sow-units. Sow weight loss during lactation is included in Table 1 as this is an important parameter. Sows may mobilise from their body tissue during lactation to ensure optimal milk production.

At the same time too much mobilisation of body tissue can have a negative impact on the upcoming reproduction cycle. The stated 6-7% reduction in sow body weight during lactation seems to be optimal under commercial conditions.

The average Danish sow productivity in 2015, based on 459 sow units and 340,000 year-sows, is shown in Table 2 together with the mean results of the top 25% and bottom 25% farms.

The traits showing most variability are pre-weaning mortality, non-productive days and percentage returns to oestrus. These traits will thus have a considerable influence on the performance of a sow unit.

Feeding scheme for lactating hyperprolific sows

Feeding the lactating sow actually starts before farrowing. The last couple of days before expected farrowing the feed intake should be adjusted to 2.4-2.8kg to avoid problems during farrowing.

After farrowing, feed intake should be increased as milk production increases. The first couple of lactation days the feed intake should be increased from approximately 2.8-3.3kg. After one week of lactation the feed intake should be increased to approximately 4.5-5.5kg.

During the first week of lactation it is recommended that the daily adjustment in feed intake is 8-10%. After two weeks of lactation daily feed intake should be between 6.0-7.5kg and after three weeks of lactation a final daily feed intake between 7.5-8.5kg should be reached.

After the first week of lactation the daily feed intake adjustments should be 4-6%. In essence, it is a semi ad libitum feeding scheme where the increase in feed supply is determined by the sow. The described feeding program leads to a total lactation feed consumption of 170-200kg feed over 28 days.

Feed intake following the scheme (Fig. 4) may not be achieved. This can be counteracted by increasing the number of daily feedings up to eight. However, this cannot be recommended in liquid feeding systems.

Research has also shown that increasing the energy concentration

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Table 4. Effect of a probiotic[1] supplemented in creep feed on pre-weaning mortality. [1]combination of B. licheniformis and B. subtilis; [2]alive the day after farrowing; *P<0.05.

	Control	Probiotic[1]	Index
Number of litters	16	16	
Alive day one per litter[2]	10.7	10.6	99
Weaned per litter	8.7	9.6*	110
Pre-weaning mortality	17.8%	8.4%*	47

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in the lactation feed is not a solution. Danish experience indicates that addition of fat in lactation feed should not exceed 2.5-3.0%.

The nutrient content of the feed is essential for optimal sow performance. The current Danish recommendation is 8.2g digestible lysine per kg lactation feed and the recommended Danish and American amino acid: lysine rations are stated in Table 3. The lactation feed should contain more calcium, phosphorus and vitamin E than other sow diets. The energy concentration in lactation feed is recommended to be between 1.05-1.10 Danish Feed-units/kg, corresponding to 9.8-10.3 MJ NE/kg or 9.2-9.7 MJ NE/kg in the French or Dutch feeding system.

Adjustments in daily feed supply should be determined approximately 30 minutes after feeding by observing feed residues in the feed trough. The standard number of feedings per day is 3-5.

Free access to high quality drinking water is required to reach the high level of feed intake scheduled above. Lactating sows have a need for 4-8 litres of drinking water per kg feed they eat and a water intake of less than 25 litres per day can be expected to have a negative effect on sow milk yield.

High temperature may also have a reducing effect on feed intake. The upper level of the thermo neutral zone for sows is approximately 20°C. Wind will cause the sow to feel comfortable at higher temperatures.

Piglet livability and sow performance

Performance enhancement is best obtained by focusing on improving the most variable production parameters: piglet mortality, sow non-productive days and return to oestrus frequency. For both piglets and sows this is about ensuring high nutrient intake from high quality feed and optimal function of the gastro-intestinal tract by securing as beneficial a microbiota as possible. Feed additives, especially probiotics, have proven to be helpful tools to reach these goals. In a study, a total of 340 suckling piglets from 32 litters were given a creep feed from day one and in half the litters the creep feed contained a Bacillus based probiotic.

The probiotic supplementation reduced pre-weaning mortality by 53%, showing that probiotics are a valuable tool to control pre-weaning mortality (Table 4).

As shown in Fig. 1, the mortality of suckling piglets, before day five of life, is mainly related to issues in connection with the early development and growth of the gastro-intestinal tract where sufficient nutrient supply and microbiota development are key players.

Probiotic application in sow feed can lead to sow shedding containing probiotics, more lactic acid bacteria and less enteric pathogens.

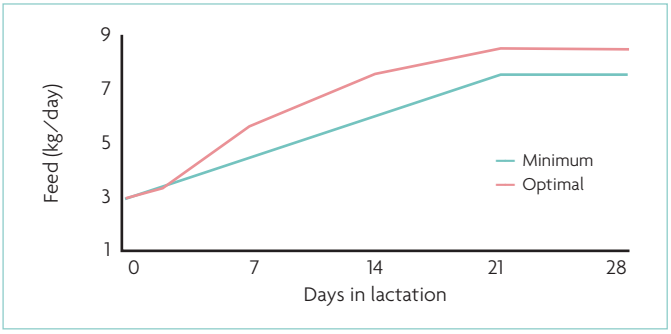
This is supporting a beneficial early development of the microbiota in suckling piglets, enhancing the piglet livability (Fig. 5).

Probiotics application in sow feed can also enhance feed utilisation of the sow leading to reduced sow body weight loss during lactation (Fig. 6). Probiotic supplementation of sows has been proven to reduce return to oestrus frequency and the number of non-productive days – most likely due to a better body score at the end of lactation.

Hyperprolific lactation sows require high focus on sow milk yield to ensure high litter weight at weaning and survivability of the suckling piglets.

It is important that feed intake increases with increasing milk production. This is best obtained by a semi ad libitum feeding strategy during lactation allowing for daily adjustments of lactation feed for each sow. Feed composition must follow recommendations and feed ingredients have to be of good quality. Feed additives, like probiotics, supplemented in sow and creep feed have through research been proven to improve livability of suckling piglets and enhance sow reproduction. ■

Fig. 4. Minimum and optimal sow feed intake per day during lactation (adapted from Bruun, 2013).



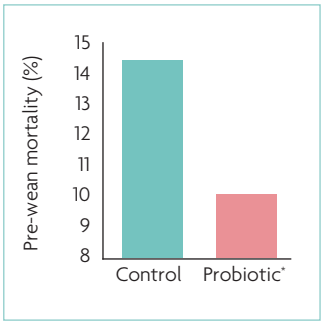


Fig. 5. Effect of probiotic application in sow feed on pre-weaning mortality (meta-analysis of four trials with 274 sows) *combination of B. licheniformis and B. subtilis.

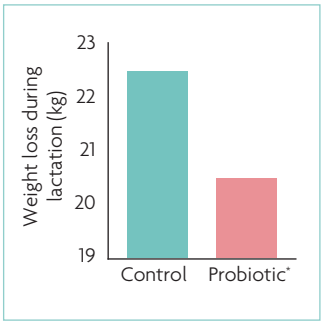


Fig. 6. Effect of probiotic application in sow feed on sow weight loss during lactation (meta-analysis of five trials with 521 sows) *combination of B. licheniformis and B. subtilis.