Meta-analysis insights unlock sow and piglet performance

Pig breeding strategies have long focused on increasing litter sizes and reducing piglet mortality, but further improvements are essential to productivity. Dietary supplements like biotics, ranging from probiotics to postbiotics, are increasingly explored for this purpose.

by Dr. Morgan Thayer, Swine Technical Services Manager, ADM andClementine Oguey, New Solutions & Sustainability Manager, Feed Additives, ADM www.adm.com

Extensive research on dietary interventions has been conducted regarding sow performance and healthy piglets. A recent meta-analysis published by ADM researchers highlights the efficacy of feeding sows with inactivated Pichia guilliermondii yeast postbiotic (PG).

This analysis provides compelling evidence that integrating PG into sow diets can boost reproductive outcomes and progeny growth performance, addressing key challenges in swine production.

KEY FINDINGS FROM THE META-ANALYSIS

The meta-analysis combines data from seven trials focused on sow reproductive and litter performance and eight trials analysing piglet growth after weaning (Tables 1 and 2).

These trials were selected through a systematic review process, ensuring that only high-quality randomised trials with appropriate controls were included. By using effect size calculations, the meta-analysis provided robust insights into how feeding sows with PG during gestation and lactation influenced outcomes such as litter size, weaning weight and post-weaning piglet growth.

Trial	Housing condition	PG sow dose (kg/t)	CON Sows (n)	PG Sows (n)	Country
Trial 1†	University	1	32	33	US
Trial 2†	University	2	32	33	US
Trial 3‡	Farm	1.5	195	200	US
Trial 4‡	Farm	1.5	105	106	US
Trial 5	Farm	1	261	272	US
Trial 6	Experimental farm	1	25	26	FR
Trial 7	Farm	1	454	350	CA

†Trials 1 and 2 occurred in the same study with two doses of PG. Each treatment group was compared to control fed sows.

‡Trials 3 and 4 occurred in the same study. Sows were separated into two treatment groups. The 395 sows had their litters weighed on a whole litter basis divided by the number of pigs in the litter. The 211 sows had their litters weighed on an individual piglet basis.

Table 1.Description of the comparisons included in the sow meta-analysis.

1. Increased Litter Size at Birth: Sows supplemented with PG exhibited higher fertility, with 0.49 more piglets born alive compared to control groups (P<0.001). This improvement in litter size included both live and stillborn piglets, as well as those classified as mummies (see Fig. 1).

2. Consistent Birth Weights: While PG supplementation did not affect individual piglet birth weight (P=0.835), the overall litter birth weight increased by 814g, highlighting improved sow reproductive performance. This suggests that PG enhances litter outcomes without compromising individual piglet development.

3. Improved Weaning Outcomes: PG-fed sows weaned 0.28 more piglets per litter than control sows (P<0.023). Piglets born from PG-fed sows tended to be weaned 0.34 d younger than those from CON-fed sows (P=0.060). Twenty-one-day adjusted pig weight at weaning tended to be lighter by 0.122 kg in the PG sow group (P=0.069); however, litter weight at weaning adjusted to 21 d remained similar across groups (P=0.516).

We can then note that this means sows can maintain the acceptable weight gains of the extra pigs they produce through PG supplementation. (Table 3)

4. Progeny Growth Post-Weaning: The benefits of PG supplementation extended beyond weaning. Piglets born to PG-fed sows showed an 18.9 g/day improvement in average daily gain (ADG) during the nursery phase (P = 0.030). This carryover effect supports the hypothesis that early nutritional interventions in sows can have long-lasting impacts on offspring performance. (Table 4)

5. Reduced Piglet Mortality: Piglets from PG-supplemented sows tended to experience lower mortality rates post-weaning, with a 27% reduction in piglet mortality (P = 0.055), suggesting that the immune-boosting properties of PG, such as its ability to activate immune responses via N-linked mannans, may contribute to better survival rates.

Table 2. Description of the comparisons included in the post weaning meta-analysis.

Trial	Housing condition	PG sow dose, kg/t	CON Piglets (Pens), n	PG Piglets (Pens), n	Duration, days	Country
Trial 1†	University	1	112 (16)	112 (16)	35	US
Trial 2†	University	2	112 (16)	112 (16)	35	US
Trial 3†	University	1	92 (16)	92 (16)	35	US
Trial 4†	University	2	92 (16)	92 (16)	35	US
Trial 5	Farm	1	627 (30)	627 (30)	42	US
Trial 6‡	Experimental farm	1	55 (4)	50 (5)	42	US
Trial 7‡	Experimental farm	1	93 (12)	88 (13)	42	US
Trial 8	Experimental farm	1	28 (7)	28 (7)	35	FR

†Trial 1 through 4 are from the same research report with two separate experiments included. Trial 1 and 2 occurred in experiment 1 with two doses of PG fed to the sow. Trial 3 and 4 occurred in experiment 2 with two doses of PG fed to the sow. Pens of pigs fed the nursery control diet were used in this meta-analysis and pens of pigs fed PG in the nursery were excluded.

‡Trial 6 and 7 are from the same research report with two separate and unequal blocks of an experiment (study 2) included.

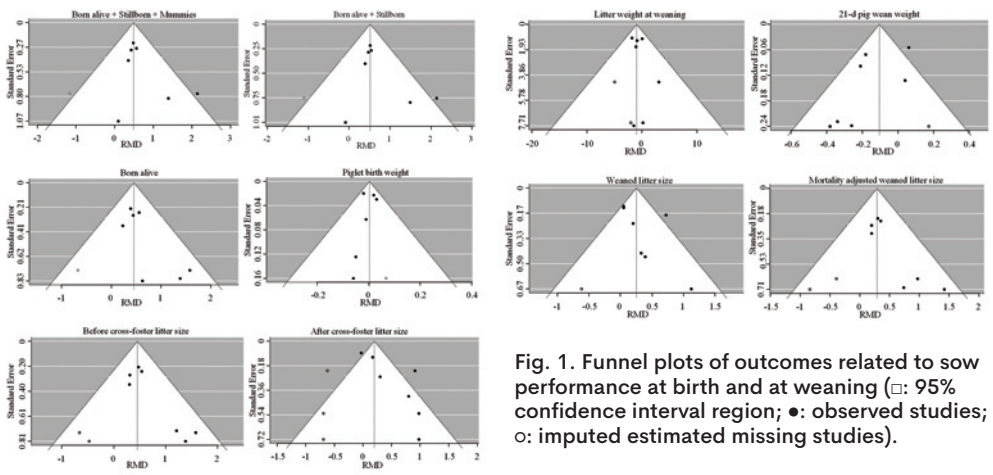


Fig. 1. Funnel plots of outcomes related to sow performance at birth and at weaning (□: 95% confidence interval region; ●: observed studies; ○: imputed estimated missing studies).

with reduced piglet mortality and improved post-weaning growth, offers a clear economic advantage. Producers can expect more piglets per litter, with a higher likelihood of survival and improved growth rates after weaning—all of which contribute to improved overall productivity. Additionally, the study's results suggest that the benefits of PG may extend beyond the immediate reproductive cycle.

The improved growth performance of progeny post-weaning points to a possible foetal imprinting effect, where nutritional interventions during gestation have long-lasting impacts on piglet health and performance. ■

MECHANISMS BEHIND SUCCESSFUL PG SUPPLEMENTATION

One potential explanation for PG's benefits lies in its immune-modulating properties. Internal ADM trials have shown that heat-inactivated Pichia guilliermondii yeast can activate cytokine production, particularly interleukin-6 (IL-6), which plays a key role in immune system regulation.

This immune system activation could enhance the resilience of piglets, both before and after weaning. Additionally, the concept of foetal imprinting may explain the improved post-weaning performance.

Feeding PG to sows during gestation could influence the development of foetal immune and digestive systems, leading to stronger, more robust piglets. This effect is likely driven by changes in the maternal immune environment that positively impact foetal development. The findings from this meta-analysis are highly relevant for swine producers attempting to enhance reproductive efficiency and piglet performance. The increase in litter size, combined

	Control		Effect size calculation				Heterogeneity	
	Mean	SEM	RMD	SE	(95% CI)	P-value	I2†	P-value
Weaning weight (kg)	6.20	0.05	-0.08	0.06	(-0.23; 0.07)	0.220	31.2	0.194
ADG (g/d)	344.2	28.6	18.9	8.7	(1.8; 35.9)	0.030	68.97	<0.001
Final weight (kg)	18.67	1.30	0.47	0.30	(-0.13; 1.06)	0.124	44.4	0.063
Mortality‡ (%)	7.65	2.67	0.73	0.16	(0.53; 1.00)	0.055	0	0.412

†I2 can be interpreted as the proportion of total variation observed between the trials attributable to differences between trials rather than sampling error (chance).
‡For the effect size calculation the odd's ratio is reported. | RMD, raw mean difference; SE, standard error; 95% CI, 95% confidence interval; ADG, average daily gain.

Table 4. Effect of P. guilliermondii yeast postbiotic fed to sows on piglet performance after weaning.

Table 3. Effect of P. guilliermondii yeast postbiotic fed to sows on litter performance from birth to weaning.

Parameter	Control		Effect size calculation				Heterogeneity	
	Mean	SE	RMD	SE	(95% CI)	P-value	I2,†	P-value
BA + SB + Mums‡ (n)	14.64	0.37	0.54	0.13	(0.28; 0.80)	<0.001	0	0.423
BA + SB$ (n)	14.33	0.40	0.56	0.13	(0.30; 0.82)	<0.001	0	0.383
BA¶ (n)	13.39	0.33	0.49	0.13	(0.24; 0.74)	0.001	0	0.636
Litter birth weight (kg)	18.614	0.742	0.814	0.248	(0.329; 1.300)	0.001	14.4	0.626
Piglet birth weight (kg)	1.413	0.018	0.003	0.15	(-0.025; 0.032)	0.835	12.6	0.654
Light weight piglets** (%)	9.99	1.87	0.75	0.95	(-1.11; 2.60)	0.431	24.8	0.292
Before cross-foster (n)	12.88	0.20	0.51	0.12	(0.27; 0.75)	<0.001	0	0.521
After cross-foster (n)	13.08	0.21	0.44	0.18	(0.10; 0.79)	0.012	77.8	<0.001
Weaned (n)	11.19	0.25	0.28	0.13	(0.02; 0.55)	0.023	58.1	0.035
Litter weight at weaning (kg)	66.67	0.82	-0.86	0.59	(-2.01; 0.29)	0.143	0	0.879
Piglet weight at weaning (kg)	5.902	0.091	-0.221	0.068	(-0.355; -0.088)	0.001	54.2	0.043
Age at weaning (days)	19.91	0.45	-0.34	0.18	(-0.69; 0.01)	0.060	87.0	<0.001
21-d pig wean weight†† (kg)	6.20	0.07	-0.122	0.067	(-0.253; 0.009)	0.069	55.8	0.026
21-d litter wean weight†† (kg)	69.29	1.65	0.50	0.78	(-1.02; 2.03)	0.516	31.0	0.320
Adjusted weaned‡‡ (n)	10.92	0.29	0.35	0.12	(0.12; 0.57)	0.003	0	0.653

†I2 can be interpreted as the proportion of total variation observed between the trials attributable to differences between trials rather than sampling error (chance).
‡Number of pigs born alive + stillborn + mummies. | $Number of pigs born alive + stillborn. | ¶Number of pigs born alive.
***The proportion of piglets lighter than 900 g at birth within a litter. | ††Individual pig and litter wean weights were adjusted to a common 21 d of age at weaning.*
‡‡The number of pigs weaned were adjusted by multiplying the number of pigs born alive by preweaning mortality. | RMD, raw mean difference; 95% confidence interval.

About the Authors:

Dr. Morgan Thayer earned her B.S. at Purdue University in Animal Sciences, M.S. at Kansas State University in Swine Nutrition, and Ph.D. at Purdue University in Swine Nutrition. Her Ph.D. research focused on gut modifying feed additives fed to sows and nursery pigs.

Morgan graduated with her Ph.D. in 2021 and directly transitioned into her current role at ADM as a Swine Technical Services Manager. She enjoys being involved with continued research of feed additives and supporting the sales team during key customer interactions.

Clementine Oguey is a Global Product Specialist and Lead for New Solutions and Sustainability for the feed additives range offered by ADM's animal nutrition business. She holds a Master of Science in Agrofood and Health from Unilasalle in France. Clementine joined Pancosma in 2006 (acquired by ADM in 2019) and has held a variety of roles in R&D, product development, technical support, and business development. She has been working with a broad range of additives categories applied to animal performance, gut health prevention, immune support and metabolic modulation as well as mycotoxins solutions.