Focusing on topical pig nutritional issues

Alltech's 21st Annual Symposium focused on nutritional biotechnology in the feed and food industries and included several very good and technical presentations that are relevant to today's pig producers. This feature reviews what was covered.

The benefits of selenium

The first presentation from G. G. Gourley and colleagues from the USA looked at the role of selenium and, in particular, the form of the selenium on piglet survivability and performance and, in so doing, reported on a major trial on a large, 3,400 sow facility in Iowa, USA.

The herd was PRRS positive/stable, enzootic pneumonia and swine flu positive. The trial centred on 756 sows whose production covered a six week period.

The sows were assigned randomly into two groups and both groups had an average parity of 3.74. Both groups received 0.3ppm selenium in their complete diets – one group received this as Sel-Plex and the other as sodium selenite and all sows began receiving the supplemented diets between 72 and 79 days of gestation.

Piglet numbers were equalised within treatment group and all litters were weaned on or after day 12. The litters born to sows of both treatments were similar (see Table 1).

When it came to litter performance, there were fewer piglet deaths per sow in the Sel-Plex supplemented sows and these sows also weaned more pigs (see Table 2).

Thus, even though the Sel-Plex supplemented sows weaned larger and younger litters, there was no adverse effect on the wean to service interval. The Sel-Plex supplemented sows' milk contained 26% more selenium.

At the nursery level 1,000 piglets that were weaned over a 48 hour period were set up into a 2 x 2 factorial treatment structure to look at the interactive effects of sow treatment and nursery treatment (both Sel-Plex v. sodium selenite).

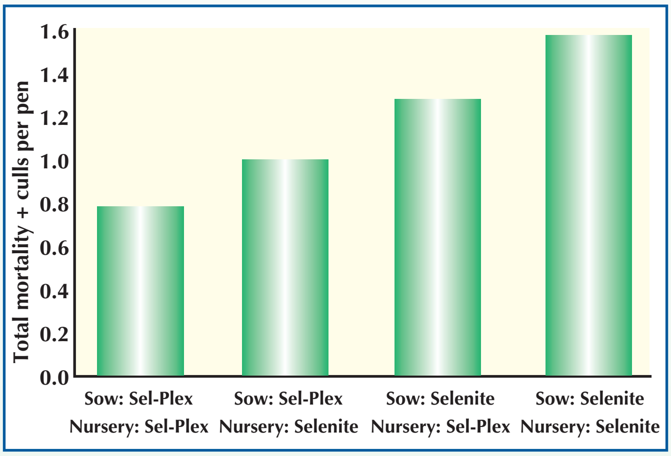

Fig. 1. Effect of sow and piglet dietary selenium source on nursery mortality and morbidity (treatment means).

Table 1. Effect of sow selenium source on litter performance.

	Sel-Plex	Selenite
Pigs weaned	9.61	9.26
Piglet deaths per sow	0.76	0.95
Wean age (days)	16.5	17.1
Litter weight (kg)	53.16	51.07
Wean weight (kg/pig)	5.51	5.50
Lactation gain (kg/litter)	37.51	35.58
Wean to service interval (days)	6.61	6.48

	Sel-Plex	Selenite
Number born alive	10.65	10.44
Number stillborn	0.81	0.87
Number mummified	0.03	0.01
Birth weight (kg)	1.50	1.54
Litter weight (kg)	15.64	15.71

Table 2. Effect of sow diet selenium source on litter performance and wean to service interval.

The results of this are summarised in Fig. 1 which shows the impact of the four treatments on nursery mortality and culls.

No effects were seen on pig end weight, daily gain, daily feed intake or FCR. It was concluded that substituting the sodium selenite with Sel-Plex resulted in more weaned pigs with a lower pre-weaning mortality (9.76 v. 11.30%).

Despite the fact that more piglets were weaned there was no adverse effect on wean to service interval.

In the nursery selenium source had no effect on performance but those that received Sel-Plex had a reduced mortality + culls figure.

It was shown that Sel-Plex enhanced piglet survival both pre-weaning and during the nursery phase. ■

Soil contamination

G. G. Mateos and colleagues from the Universidad Politécnica de Madrid in Spain gave a comprehensive review of mineral nutrition in pig.

This included some very interesting data on the relationship between zinc and copper levels in the feed and their subsequent build up in the soil.

This is summarised in the two tables below. ■

ZINC

Scenario	**A**	**B**	**C**
Zinc in piglet feed (ppm)	100	2,000	3,000
Zinc in fattener feed (ppm)	60	100	150
Zinc excreted (g/pig)	14	36	60
Zinc (mg) per kg DM slurry	450	1,120	1,860
Time needed (years) to reach 300mg zinc per kg soil			
Minimum	270	110	55
Maximum	1,100	390	190

COPPER

Scenario	**A**	**B**	**C**
Copper in piglet feed (ppm)	6	175	175
Copper in fattener feed (ppm)	4	35	100
Copper excreted (g/pig)	1	14	29
Copper (mg) per kg DM slurry	31	443	911
Time needed (years) to reach 300mg copper per kg soil			
Minimum	647	83	16
Maximum	16,024	289	56

Selenium in first parity

Canadian workers from Quebec, Canada considered the impact of Sel-Plex or inorganic selenium for hyperovulatory first parity sows.

It has been known for some time that increased ovulation rate in pigs adversely affects embryonic survival and it is thought that this relates to the reduced quality of shed oocytes and the consequences of this on subsequent fertilisation and/or the ability of embryo cells to differentiate or develop.

Some work in other polytocous species suggests that ovarian metabolism is very active and that this results in the generation of reactive oxygen species and free radicals that are potentially toxic and can damage ovarian tissue.

These toxic metabolites must be neutralised locally if tissue integrity and function are to be maintained and this can be brought about by reactions with antioxidants such as the enzymatic degradation of various peroxides of selenium by selenium dependant glutathione peroxidase.

Lipid soluble vitamin E is a known non-enzymatic that neutralises reactive oxygen species and free radicals and it is considered that nutritionally a sparing effect exists between vitamin E and selenium for the antioxidant capacity of the animal.

The objective of the Canadian study was to assess the effect of dietary selenium as inorganic selenium (sodium selenite) or Sel-Plex (organic selenium) on the performance of gilts.

The results are summarised in Tables 1, 2 and 3.

It was concluded that the selenium status response was affected by the level and type of dietary selenium supplement used.

Organic selenium (Sel-Plex) substantially increases blood selenium. GSH-Px responded to type of supplement.

This suggests that hyperprolific type sows would benefit from organic selenium supplementation.

In such scenarios dietary organic selenium is critical for an efficient selenium transfer to embryos. ■

	Control (0ppm)	Selenite (0.3ppm)	Sel-Plex (0.3ppm)
Litter size	14.3	14.3	15.2
Mean embryo weight (g)	1.36	1.31	1.46
Litter weight (g)	19.2	18.8	22.3
Litter variation in embryo weights (%)	9.63	8.53	7.81
Mean embryo length (mm)	20.5	20.1	21.2
Litter variation in embryo length (%)	6.13	4.83	6.11
Total protein/litter (mg)	57.5	55.7	62.2
Litter variation in embryo protein (%)	11.8	11.4	10.4

Table 1. Reproductive performance and embryonic development at 30 days of gestation according to dietary selenium source.

Table 2. Selenium transfer to embryos and their antioxidant status at 30 days of gestation according to dietary selenium source.

	Control (0ppm)	Selenite (0.3ppm)	Sel-Plex (0.3ppm)
Total selenium in litter (µg)	2.99	2.74	4.46
Mean embryo selenium (ng)	208.4	196.5	284.3
Total litter variation in embryo selenium (%)	18.6	15.6	14.7
Total ferric reducing antioxidant power in litter (M)	14.6	14.7	16.1
Mean embryo reducing antioxidant power (M)	1.04	1.02	1.08
Litter variation in embryo ferric reducing antioxidant power (%)	9.56	10.30	6.99
Total Se-GSH-Px in litter (U/mg protein)	753.6	780.5	800.2
Mean embryo Se-GSH-Px (U/mg protein)	53.5	54.6	54.8
Litter variation in Se-GSH-Px (%)	23.1	20.0	18.9

	Control (0ppm)	Selenite (0.3ppm)	Sel-Plex (0.3ppm)
Number of CL.	21.4	24.3	23.6
Mean CL weight (g)	0.18	0.16	0.16
Total CL weight per sow (g)	9.88	8.65	9.48
Litter variation in CL weight (%)	39.0	39.3	39.5
Mean CL diameter (mm)	14.3	14.3	14.2
Litter variation in CL diameter (%)	7.31	6.39	7.38
Total CL protein/sow (mg)	207.2	210.5	225.9
Total CL selenium per sow (µg)	1.99	1.96	1.84
Total CL ferric reducing antioxidant power/sow (mM)	393.2	385.4	396.0
Total CL Se-GSH-Px/sow (U/mg protein)	296.6	382.7	361.4

Table 3. Development, selenium transfer and antioxidant status in corpora lutea (CL) at 30 days of gestation according to dietary selenium source.

Mineral nutrition issues

Bruce Mullan and colleagues from Western Australia reflected on various aspects of mineral nutrition. In general, recent reviews had found that the concentrations of trace metals used in pig nutrition were higher than those recommended by researchers. The biggest excesses were seen for copper and manganese in sows and for cobalt and iodine in all classes of pigs.

Traditionally, inorganic mineral salts such as sulphates, carbonates, chlorides and oxides are added to diets to provide the assumed correct levels to meet the animals' needs. These salts are broken down in the digestive tract to produce free ions and, unfortunately, these ions can then form complexes with other dietary molecules and this makes the minerals more difficult to absorb.

These free ions are also very reactive and interactions between various minerals are known to occur and need to be taken into account when planning a nutritional programme.

For example, some 75-80% of ingested zinc from inorganic sources is excreted by animals.

So, there is interest in using forms of minerals that are better absorbed and utilised by the animals. Organic minerals provide better availability and can be used to replace their inorganic counterparts. However, organic minerals are more expensive and so it is important to balance additional costs against benefits in pig performance, improvements in product quality and reduced environmental impact.

	Control	Bioplex
Ultimate pH	5.39	5.40
Surface lightness (L)	54.10	52.30
Drip loss (%)	6.5	3.6
PSE (%)	50	15

Table 2. The effect of dietary Bioplex magnesium supplementation on meat quality indicators in the Longissimus thoracis muscle 24 hours post slaughter.

In one study piglets received diets containing no added zinc, 1,500-2,250ppm zinc from inorganic zinc oxide or 250ppm zinc from Bioplex. At the end of the 60 day trial the pigs receiving the

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Table 1. The growth performance and carcase characteristics of male pigs fed diets with different types and levels of supplemental copper.

	Copper sulphate 20ppm	Copper sulphate 200ppm	Bioplex 100ppm
Start weight (kg)	28.0	27.5	27.9
Final weight (kg)	88.7	90.7	91.7
Average daily gain (g)	726	731	766
FCR	2.51	2.44	2.43
Carcase weight (kg)	64.3	67.7	68.8
P2 fat thickness (mm)	9.6	9.6	9.7
Dressing percentage (%)	74.5	74.8	75.1

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Bioplex were 11% heavier and the indications were that using this product had advantages over the higher levels of zinc oxide. A similar scenario was seen with copper in growers (see Table 1).

Magnesium has a relaxant effect on skeletal muscle and dietary supplementation with magnesium has been shown to alleviate the effects of stress by reducing plasma cortisol, norepinephrine, epinephrine and dopamine concentrations.The use of the organic magnesium in Bioplex for two days before slaughter has been shown to reduce drip loss and also lower the incidence of PSE (see Table 2). ■

Bio-Mos in sow diets

Mannan oligosaccharides appear to offer opportunities to improve animal performance and of these Bio-Mos from Alltech is the most thoroughly researched.

In this presentation James E. Pettigrew and colleagues from Illinois, USA, reviewed various recent trials with Bio-Mos. The results of these trials are summarised in Table 1.

It was concluded that Bio-Mos during late pregnancy increases piglet birth weights and that piglets fed Bio-Mos were, on average, 74g a piglet heavier.

Adding this product to the sow's ration also appears increase pre-weaning growth rate and weaning weight. Piglet mortality pre-weaning was also decreased.

It appears that the Bio-Mos in sows' diets advantage on progeny performance may well extend past weaning.

Why should this be? Why should using Bio-Mos in the sows give such benefits to the resulting piglets?

Perhaps the answer lies in the data in Table 2 which shows that the addition of this product is accompanied by a significant increase in immunoglobulin concentrations in the colostrum.

The wean to oestrus interval was reduced by Bio-Mos by a remarkable two days.

When this is considered in economic terms Bio-Mos gives a net benefit of over $US13 (see Table 3 right). ■

Table 1. Recent trial results.

BREEDER PERFORMANCE				
Location	**N. Carolina**	**Spain**	**Missouri**	**Kentucky**
Number of sows	1,026	80	318	24
Days fed Bio-Mos				
Gestation	<21	14	21	14
Lactation	21	28	18	21
Bio-Mos dose				
Gestation	0.2%	0.2%	5g/d	5g/d
Lactation	0.1%	0.1%	5g/d	5g/d
Litter size - Total born				
Control	11.12	11.20	12.47	11.25
Bio-Mos	10.97	11.90	12.13	10.17
- Born alive				
Control	9.96	9.80	11.00	10.17
Bio-Mos	9.78	10.30	10.76	8.83
Effect of Bio-Mos in sow diets on piglet weights				
Birth weight (g) - Control	1660	1540	1380	
- Bio-Mos	1692	1700	1410	
Difference (g)	32	160	30	
Effect of Bio-Mos in sow diets on weaning data				
ADG (g) - Control	177	178	245	
- Bio-Mos	195	194	240	
Difference (g)	18	16	-5	
Weaning weight (kg)				
- Control	5.46	6.52	5.63	
- Bio-Mos	5.79	7.12	5.77	
Difference (kg)	0.33	0.60	0.14	

	N. Carolina	**Missouri**	**Kentucky**
Immunoglobulin G (mg/dL)			
Control	4,842	5,728	3,566
Bio-Mos	5,853	5,737	4,216
Immunoglobulin A (mg/dL)			
Control	1,097	518	667
Bio-Mos	1,178	536	629
Immunoglobulin M (mg/dL)			
Control	241	254	316
Bio-Mos	273	288	440

Table 2. Effect of Bio-Mos in sow diets on colostral immunoglobulin concentrations.

Table 3. Estimated costs and returns on a per litter basis for using Bio-Mos.

	$US
Increased pre-weaning survival	6.30
Increased pre-weaning growth rate	1.82
Increased post-weaning growth rate	5.19
Increased wean to oestrus interval	0.77
TOTAL RETURNS	**14.08**
Cost of Bio-Mos	0.74
NET BENEFIT PER LITTER	**13.34**

Enzyme preparation

This paper at the Symposium came from Brazil and focused on Allzyme Vegpro, an enzyme preparation that contains galactosidase, amylase, cellulase, protease and pentosanase.

In the period after farrowing and post weaning the use of soybean meal in pig diets is limited because of the low secretion of proteolytic enzymes by the young pig and the presence of anti-nutritional factors which lead to hypersensitivity reactions, damage to the intestinal lining, diarrhoea, poor performance and, on occasions, even death. The use of Vegpro results in higher weight gains and better FCRs (see Table 1).

In other research (Table 2) no significant differences were found in the performance of pigs fed different diets. ■

	Control	**+ Vegpro**
Number of pigs	92	74
Days on trial	7	7
Average initial weight (kg)	20.0	20.6
Average final weight (kg)	24.1	25.1
ADG (g)	604	667
FCR	1.62	1.55
Extra liveweight per tonne feed (kg)		27.88

Table 1. The effect of Vegpro on the performance of growing pigs.

Table 2. The performance of pigs fed different diets.

	Corn/soya		**Corn/soya/wheat middlings**	
	Control	**+Vegpro**	**Control**	**+Vegpro**
26-63kg				
Daily gain (kg)	0.77	0.84	0.72	0.71
FCR	2.57	2.29	2.91	2.76
63-109kg				
Daily gain (kg)	0.82	0.88	0.79	0.78
FCR	3.28	3.16	3.91	3.90
26-109kg				
Daily gain (kg)	0.80	0.86	0.77	0.75
FCR	2.96	2.75	3.48	3.41