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Effect of dietary non-starch polysaccharide solubility and inclusion level on gut health and the risk of post weaning enteric disorders in newly weaned piglets ☆

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Abstract

The objective of this experiment was to investigate the effect of non-starch polysaccharide (NSP) solubility and inclusion rate on gut health and development, performance and risk of post weaning enteric disorders (PWED) using NSP sources known not to affect digesta viscosity. The experiment consisted of a 2×3 factorial combination of NSP type (sNSP vs insoluble NSP (iNSP); inulin vs purified cellulose) and inclusion level (50 vs 100 vs 150 g/kg). Piglets were weaned at 28 days (day 0) and fed *ad libitum* until slaughter on day 14. There were no incidences of PWED. NSP solubility had little effect on performance, but sNSP diets resulted in lower caecal and colonic pH and higher colonic *Lactobacilli* to coliform ratio compared to iNSP diets. Increasing NSP levels significantly reduced caecal and colonic pH but decreased empty body weight percentage ($P=0.067$). These results suggest that gut health may benefit most from diets containing appropriate sources of predominantly sNSP rather than iNSP. The optimal level of such sNSP will likely depend upon the level of risk of PWED in order to balance the trade off between maximising performance and improving gut health. Effects of NSP feeding under a higher infectious pressure remains to be assessed.

Keywords: Health; Non-starch polysaccharides; Performance; Pig; Weaning

1. Introduction

It has been suggested that non-starch polysaccharides (NSPs) may be added to weaner diets in order to improve gut health and reduce the incidence of post weaning enteric disorders (PWED) by reducing the proliferation of potential pathogens in the gastrointestinal tract (e.g. Bertschinger et al., 1978). Aumaitre et al. (1995) suggested that appropriate fibrous feeds could be added to supply potentially fermentable NSPs to the flora of the large intestine, thereby promoting physiological and functional development. In turn, this would decrease the need to ferment protein as an energy source, thus reducing the formation of biogenic amines and reducing the incidence and severity of PWED (Pluske et al, 2002). NSPs in the starter diet therefore could not only prevent digestive disturbances in the weaner pig, but also contribute to the adaptation of the digestive function of the large intestine.

Soluble NSPs that lead to high digesta viscosity have been shown to increase the occurrence and severity of

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PWED (e.g., McDonald et al., 1999). However, as the effect of NSP solubility appears not to have been investigated in isolation to effects on digesta viscosity, any detrimental effect of sNSP may be due mainly to the associated increase in digesta viscosity. Therefore, the objective of this experiment was to investigate the effects of NSP solubility and inclusion rate on gut health and development, performance and risk of PWED using NSP sources known not to affect digesta viscosity.

2. Materials and methods

The experiment consisted of a 2×3 factorial combination of NSP type (insoluble (iNSP) vs soluble NSP (sNSP)) and inclusion level (L vs M vs H). At weaning (day 0) 48 pigs (Large White×Landrace) aged 27.6±2.66 days (±S.D.) were balanced for litter, initial weight and sex and offered *ad libitum* access to one of the six dietary treatments. The increase in sNSP and iNSP was achieved by increasing inulin (Raftifeed® IPS (approx 94% inulin), Orafti Active food ingredients, Tienen, Belgium) and purified cellulose (Solka-floc®, International Fiber Corporation, New York, U.S.A.) respectively from 50 g/kg in the L diets to 100 and 150 g/kg in the M and H diets respectively. All diets contained similar amounts of cereal (i.e. background NSP) and were balanced for crude protein (230 g CP/kg), DE (16 MJ DE/kg) and amino acid composition. Individual feed intakes and faecal consistency (assessed through a subjective four point scale where 1=firm and 4=watery) were recorded daily, and pigs were weighed on days 0, 7 and 14. Animals were euthanased on day 14 to assess gut health (as indicated by digesta pH and the ratio of *Lactobacilli* to coliforms) and development. The number of *Lactobacilli* and coliforms were recorded through standard enumeration techniques after 24 hours aerobic incubation (39 °C) on MacConkey agar and after 48 hours anaerobic incubation (39 °C) on MRS agar respectively. All animals were individually housed. Data were analysed using the REML procedure of Genstat (2001) (Lawes Agricultural Trust, Rothamsted, Herts., UK). Body weight at weaning was used as a covariate, individual pig as the experimental unit and litter as a random factor. *Lactobacillus* and coliform counts were $\log_{10}$ transformed before analysis and calculation of the *Lactobacilli* to coliform ratio (L:C). The animal experiment committee of SAC approved this work.

3. Results

3.1. General health and faecal scores

There were no apparent health problems throughout the trial. Piglets on the sNSP diets had significantly lower faecal scores (FS) than those on the iNSP diets, averaging 1.44 and 1.77 ($P<0.001$) respectively over the two-week trial period. Increasing NSP inclusion level had no effect on FS with a mean (±s.e.) FS of 1.53 (±0.11), 1.70 (±0.14) and 1.58 (±0.12) for the L, M and H diets respectively over the experimental period.

3.2. Post mortem

The empty organ weights and digesta contents of pigs on the experimental treatments are shown in Table 1. Piglets on the sNSP diet tended to have lighter small intestine (SI) organ and digesta weights and

Table 1
Effect of NSP solubility (sNSP vs iNSP) and inclusion level (H vs M vs L) on empty organ and digesta weight from samples taken at slaughter on day 14 post weaning

	Empty organ weight (g)				Empty organ weight (g/100 g empty digestive tract				Digesta (g)			
Treatment	ST	SI	CM	CO	ST	SI	CM	CO	ST	SI	CM	CO
Hs	102	780	47	309	8.3	63.0	3.7	25.0	175	203	117	252
Hi	111	876	44	294	8.4	66.2	3.4	22.0	177	308	96	258
Ms	105	816	46	265	8.5	66.3	3.7	21.5	138	217	103	223
Mi	114	848	34	246	9.3	68.1	2.8	19.9	198	230	34	152
Ls	112	835	37	250	9.1	67.7	3.0	20.3	143	206	50	167
Li	105	847	36	253	8.5	68.4	2.9	20.3	139	224	71	174
SED[a]	6.83	44.7	4.4	20.7	2.64	1.76	0.94	2.20	59.2	33.5	16.9	26.0
Response[b, c]			*I**	*I***		*I****	*I***	*I**		*S**	*I**	*I****
			S*			*S***	*S***	*S**			*S****	*I*×S**
							I×S****				*I*×S****	

[a] s.e.d. standard error of the difference for the *I*×*S* interaction.
[b] *I*=inclusion level (H vs M vs L), *S*=solubility (*S* vs *I*).
[c] *$P<0.05$, **$P<0.01$, ***$P<0.001$.