A sustainable approach to pig intestinal health and performance

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Feed transition, housing change, separation from mother and litter, physiological and immune variations are some of the great changes of weaning. Piglets are facing multi-factorial stresses in a short time and one of the most visible impacts of these stresses is the great decrease in feed intake after weaning. This drop in feed intake is likely to cause difficulties to cover growth requirements, due to a reduction in villosity height and thus in the nutrient absorption area, and in mobilisation of fat and muscle reserves.

Besides these consequences, there are non-visible impacts at physiological and metabolic levels. Indeed weaning means the first encounter between piglets and some raw materials.

Consequently, animals have to adapt their enzymatic system in order to digest these new raw materials, which is an important physiological change. As the first reaction of piglets' organism is to consider new feed as an antigen, they also have to adapt their immune system in order to accept this new feed.

As 70-80% of the immune cells are located in the gut, this adaptation can generate local inflammation and oxidative stress. In contact with antigens, macrophages induce the production of pro-inflammatory and oxidative stress markers. This consumes a lot of energy and nutrients.

To help animals cope with this stressful period, a combination of plant extracts has been developed (Powerjet) and tested in the farm of an agricultural school. These natural active ingredients have been selected for their anti-inflammatory and anti-oxidant properties.

A preliminary in vitro study has demonstrated the synergistic action between the three active molecules selected (patented) on intestinal health.

One additional described property of these plant extracts is the modulation of intestinal motility which can be interesting to reduce diarrhoea disorders.

No plant extracts	With plant extracts	Difference
0.46 dead piglet/sow	0.17 dead piglet/sow	P<0.1

Table 1. Piglet mortality between 24 hours after farrowing and weaning.

	No plant extracts	With plant extracts	Difference
Weight loss from start and end of maternity period (kg/sow)	35.2	36.7	NS
No. of live born piglets	14.90	15	NS
No. of weaned piglets	12.2	12.4	NS
Daily feed intake of lactation feed (kg/d/sow)	6.13	6.11	NS
Average weight of piglets at weaning (kg/piglet)	6.5	6.5	NS

Table 2. Maternity results.

Preliminary in vitro research

A university trial was conducted in Beauvais, France, in order to assess the impact of the three plant extracts on both intestinal integrity and inflammatory process. Human colon cells have been cultivated and then stimulated with a severe model of inflammation (cancer).

One of the plant extracts and the combination of the three plant extracts have been tested to evaluate their impact on trans-epithelial resistance (TER) and Interleukins 8 (IL 8).

Trans-epithelial resistance is an indicator of intestinal integrity. Interleukins 8 are pro-inflammatory markers and their production is reflecting the level of the inflammation. Results of this preliminary research are shown in Figs.1-2.

These results assess the interest of such a combination of three plant extracts on two important criteria: preservation of intestinal first integrity – favouring proper absorption of nutrients and inflammatory process modulation in case of challenge (mimic of stress conditions at farm) allowing saving energy for production.

Then, these physiological results were validated at a zootechnical level through an in vivo trial.

In vivo piglet trial

● **Animals:**

A total of 77 sows (Youna genetic line) from three successive batches were divided into two groups: half of them were fed with the combination of plant extracts 15 days before farrowing and during the whole lactation (21 days). The other half was fed without feed additive. After weaning, 624 piglets from these 77 sows were followed during the post-

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Fig. 1. Impact of plant extracts combination on intestinal integrity.

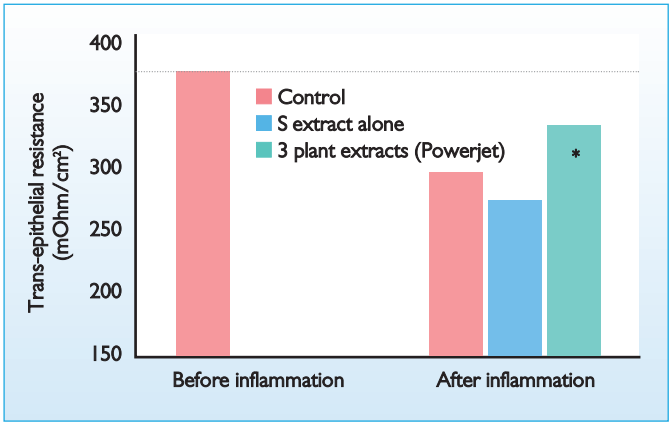
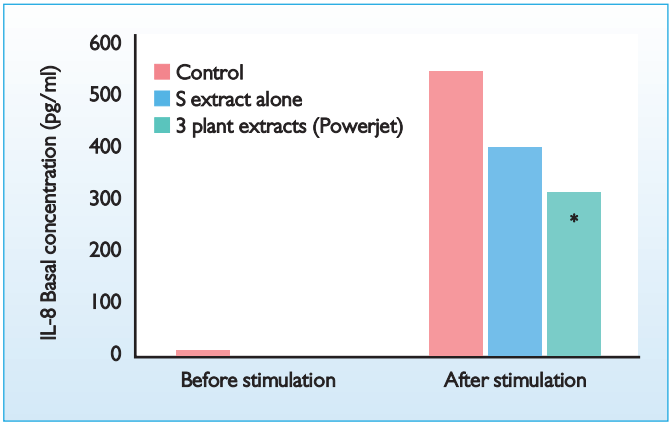


Fig. 2. Impact of plant extracts combination on inflammatory process.



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weaning period: half of them were fed with the plant extracts combination and the other half without feed additive. Four different groups of piglets were constituted depending on their own diet and depending on their mother's diet (Fig. 3).

Plant extracts combination was distributed to half of the piglets from weaning (21 days of age) until the end of the post-weaning period (67 days of age). Pre-starter feed was offered from 2-42 days of age, and starter feed from 42-67 days of age. All formulas were without antibiotics, zinc oxide or acidifier and were distributed ad libitum.

Diets:
During gestation and lactation, feed specifications were respectively as follows: 2985kcal/kg digestible energy, 13.5% crude protein, 4% fat, 0.67% lysine; 3400kcal/kg digestible energy, 16.8% crude protein, 5.1% fat and 1.01% lysine.

Pre-starter and starter feed specifications were respectively as follows: 19.2% crude protein, 6.8% fat and 1.30% lysine; 16.5% crude protein, 1.7% fat and 1.2% lysine.

Measurements:
The following parameters were recorded in the farrowing room: sows' weight at the entry in the rooms and at weaning (21 days), feed intake of sows, piglets' weight at birth, 24 hours after birth and at weaning, number of dead and alive piglets at farrowing, 24 hours after birth and at weaning. The number of dead piglets or sows was recorded daily. Statistical evaluation of weight, prolificity, percentage of mortality was made with the analysis of variance method. The number of dead piglets in each group was treated with the Chi² method. In the post-weaning period, piglets' weight and feed intake were measured weekly and feed conversion rate and average daily gain were calculated. The number of dead piglets was recorded every day. Data were subjected to analysis of variance.

Results

Maternity (farrowing to weaning):
The number of dead piglets per sow between 24 hours after farrowing and weaning tended to decrease with the use of plant extracts (Table 1, $p<0.1$): 0.17 dead piglets in the test group compared to 0.46 dead piglets in the control group. There was no significant impact of the plant extracts on other maternity performance such as prolificity, sows and piglet weights (Table 2).

Post-weaning:
Average daily gain (ADG) of piglets in post-weaning was significantly improved with the plant extracts (Fig. 4). The best performance was obtained with the group of piglets fed with plant extracts post-weaning and originating from sows also fed with plant extracts.

The ADG of this group of piglets was improved by 11.4% ($p<0.001$) compared to the ADG of the control group (without plant extracts in sow and piglet diets). Groups of piglets fed with plant extracts only in maternity or only in post-weaning obtained better results than those of the control group (+4.9% and +3.5% respectively).

An improvement in ADG was observed in the global post-weaning period but also during the pre-starter and the starter periods.

During the prestarter period, the group fed with plant extracts in maternity and in post-weaning had a 30% higher ADG than the negative control group (+53g/d, $p<0.001$).

During the starter period, the ADG of piglets receiving the plant extracts was 6.1% ($p<0.05$) higher than those receiving the control diet. At the end of the post-weaning period, live weight of piglets was increased by 2.15kg/piglet ($p<0.01$) in the group fed with plant extracts in maternity and post-weaning (29.44kg/piglet at 67 days of age) compared to the negative control group (27.29 kg/piglet at 67 days of age).

Feed intake tended also to be improved by plant extracts combination: 7% (NS) of additional feed intake was obtained in the group fed with natural active ingredients in maternity and post-weaning compared to the negative control group.

Consequently, feed conversion rate also tended to be improved (NS) in the plant extracts group: 4.3% of improvement compared to the control group (Table 3).

This trial has demonstrated the great impact of sow diet on piglet performance.

The best results were obtained when the plant extracts combination was distributed to sows from maternity period and then to piglets from weaning until the end of the post-weaning period.

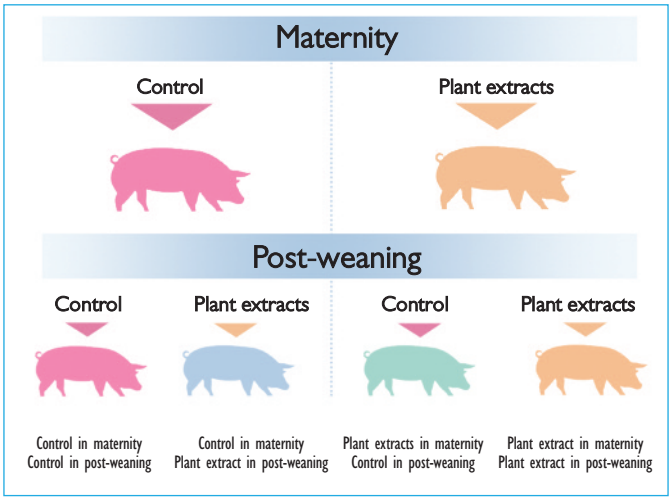

Fig. 3. Experimental design.

When plant extracts were distributed only in maternity or only in post-weaning, the performance of piglets in post-weaning was better than those of the negative control group but lower than those of the group with plant extracts distributed during both periods.

This indicates a cumulative effect of these plant extracts on piglet performance. Besides this cumulative effect, there is also what we can call a 'back-effect' of the distribution of plant extracts in maternity on post-weaning performance. Indeed, when plant extracts are distributed in maternity, the main effects are visible on piglets after weaning and not during the distribution in maternity.

This result highlights the great impact of sows' metabolic stress management on future piglet performance. When sows receive plant extracts with anti-inflammatory and anti-oxidant properties, they may produce milk of better quality (a decrease in piglet mortality in maternity) and, consequently, better prepare their litter to face weaning changes.

Conclusion

Combining plant extracts with different properties allows higher benefit from synergies to better face inflammatory and oxidative processes around weaning. This trial highlights the maternal impact on weaning preparation.

Inflammatory and oxidative processes can be calmed down during lactation. The right management of sows during this period has indirect impacts on piglets' performance after weaning. ■

Table 3. Daily feed intake and feed conversion rate of piglets.

	Piglets in post-weaning (20-67 days of age)	
	No plant extracts	With plant extracts
Daily feed intake (g/d)	687	735
Feed conversion rate	1.62	1.55

Fig. 4. Effect of plant extracts distributed in maternity and/or in post weaning on average daily gain (ADG) of piglets.