WHY IT MAKES SENSE
USING PHYTOGENIC FEED ADDITIVES IN GROWER-FINISHER PIGS

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Phytogenic feed additives (PFAs) comprise a wide range o plants like herbs, spices, and other plant-derived products such as essential oils and oleoresins (Windisch et al., 200 Although this kind of feed additive has been known for a long time, its use is not yet as common as feed enzymes c pre- and probiotics. A recent survey on the usage of PFAs published in Sciences & Solutions, Phytogenics (2017) indicates that from a total of 1140 responders (36% poultr producers, nine percent swine producers, 14 percent feed milll operations, 29 percent consultants and 13 percent other), 51 percent are currently using phytogenic feed additives in their feeding programs, being slightl higher in EU (57%) compared to other regions.

Based on the survey, PFAs would be applied in five percent of total worldwide livestock feed tonnage per year. Among several reasons for using PFAs, the mair ones are digestibility enhancement, antimicrobial effects linked to AGP replacement strategies, improved FCR and higher feed intake.

Digestibility enhancement, citing the survey means more complete use of feed, resulting in improved feed efficiency and lower emissions that accompany a reduced environmental footprint". This, in turn, is linked to growth promoting effect and improved FCR.

Furthermore, the survey summarises the main benefits that customers valu in PFAs, which were (in decreasing order):

1: Enhanced feed efficiency/better FCR
2: Reduced medicinal costs
3: Enhanced growth (carcass yield)
4: Enhanced reproductive performance
5: Better uniformity
6: Increased feed intake
7: Better meat quality
8: Nutrient-sparing effect
9: Emissions reduction (e.g. ammonia)

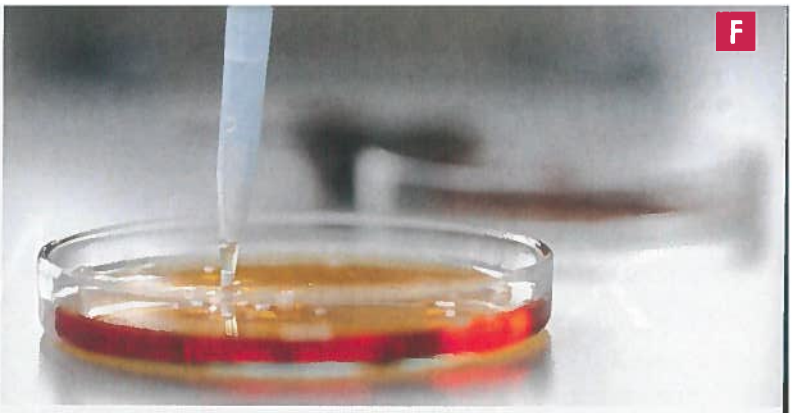
Focusing on the phase of growing-finishing pigs (20-115kg BW), which represents 60-70 percent of total cost of pig production, the main reasons why customers might use PFAs and most desired benefits are a digestibility enhancement and an improved FCR (and better meat quality), alongside with simultaneously reduced medicinal costs. A reduction of emissions is definitely a strong reason in some regions due to environmental concerns. Although the latter arguments have been important in the EU and US for quite some time, it is becoming increasingly important in Latin America as well as North and South Ea Asia. Finally, production costs and ROI are always in the spotlight.

Effects of Fresta® F as Delacon's zootechnical additive for piglets with proven effects on performance and piglet homogeneity are not dealt with in this article.

Aromex® ME and Aromex® Pro are phytogenic feed additives, fully using synergistic effects of plant-derived active substances. They feature a carefully selected composition of phytogenic active substances, like essential oils and othe plant extracts, perfectly aligned to the needs of growing-finishing pigs. They consist of a blend of microencapsulated essential oils.

Delacon added a unique blend of saponins to reduce ammonia and odour emissions accompanying the digestibility enhancement. Moreover, these saponin were shown to increase nutrient transporters on the enterocytes, further improvin nutrient digestibility.

To realise the full growth potential of fattening pigs, they need optimal nutrient supply adjusted to their respective phase of life. The combination of active ingredients in Aromex® (ME and Pro) achieves slower passage rates of digesta



without negative effects on feed intake. In combination with a higher nutrient uptake as well as an enhanced utilisation and retention of dietary energy and protein supplies, this will lead to an increased animal growth, and thus, to a higher profitability. Furthermore, the additives enhance stress tolerance due to the high antioxidant power of the used plant ingredients.

Moreover, Aromex® Pro contributes to an inhibition of ammonia formation, which arises in the course of pig fattening.

Increased digestibility results in enhanced feed efficiency

Many aromatic plants, spices and essential oils are shown to be potent to stimulate digestive secretions (saliva, mucus), pancreatic enzymes production and bile secretion in the intestinal tract, being beneficial to the animal (Franz et al 2010, Platel and Srinavasan, 2004 and Van der Klis & Vinyeta, 2014).

As a result of increased digestive secretions and enzyme production, together with a healthier gut mucosa, nutrients are better digested and absorbed and several studies (Maenner et al, 2011; Li et al., 2012; Ahmed, 2013) have reported an increased ileal and fecal digestibility of dry matter and crude protein due to a supply of phytogenic feed additives.

The effects of essential oils, herbs and spices on improved performance in pigs were quantified by Franz et al. (2010) based on 26 piglet trials, showing 2.5 percent improved body weight gain (ranging from -5% to +9%) and three percent improved feed conversion ratio (ranging from +4% to -10%), whereas feed intake was not affected (ranging from -9% to +5%, average +0.5%).

This results in an improved performance index and an increased nutrient utilisation (higher body weight gain at a similar feed intake in piglets). The same authors described that the primary mode of action of growth promoting feed additives is the beneficial effects on the ecosystem of gastrointestinal microflora by controlling potential pathogens. Hence, animals are less exposed to microbial toxins or other undesired metabolites, e.g. ammonia and biogenic amines, and therefore the pigs will benefit by an improved intestinal health. This latter effect has positive impact on pig uniformity.

In an experiment conducted by Freie Universität Berlin, the effects of Aromex® Pro (100ppm) were evaluated on nutrient digestibility and performance in 25-50kg BW pigs. The supplementation of pig diets with PFA improved apparent ileal digestibility of crude protein and amino acids > 3.0% (Figure 1). Moreover, Figure 2 demonstrates that supplementation increases production performance (daily weight gain: 5.2%, P=0.004; feed conversion ratio: 3.6%, P<0.001) as well as faeces consistency (data not shown).

When looking more closely, the data of body weight at the end of a trial at Delacon's Performing Nature Research Center (42 days trial period; castrated males and females pigs: average BW 30-80 kg at start and end of trial period, respectively; 12 replicates per treatment; 3 pigs/replicate), it was clear that not only body weight gain was improved. Data presented in Figure 3 clearly show that pig body weight distribution was improved by Aromex® Pro treatment

compared to Control treatment.

Although it is a difficult parameter to confirm in field trials, because it's almost impossible to weigh pigs individually at commercial farms, it is definitely a parameter to consider as homogeneity has a big influence on farm management costs. Moreover, the aforementioned survey (Sciences & Solutions, Phytogenics, 2017) indicated uniformity as one of the main benefits of PFA that customers value most.

Dietary supplementation of essential oils shows antioxidant and anti-inflammatory activities as described for essential oils in recent reviews (e.g. Saleh (2010), Brenes and Roura, 2010; Miguel, 2010; De Cassiada Silveira, 2013, Zeng 2014). Cai et al. (2004) showed a clear relationship between radical scavenging capacity and the phenolic nature of essential oils. In Saleh (2010), from a total of 248 essential oils belonging to 18 botanical families of medicinal, herbal and wild flora, only 7 percent were found to have high antioxidant and radical (reactive oxygen species (ROS) and reactive nitrogen species (RNS)) scavenging activities, being related to components like oxygenated monoterpenoids, monoterpens hydrocarbons and monoterpene phenols.

In addition, essential oils have indirect antioxidant activity by up-regulating the intracellular production of antioxidant enzymes, like SOD and GSH-Px (Franz et al., 2010), for both phenolic (like oregano and thyme oil) and non-phenolic essential oils (like turmeric and rosemary oil).

According to Mueller et al (2012), phytogenic feed additives up-regulate the antioxidant system of piglets either by direct or by indirect antioxidant effects and they may thereby improve animals' health status. Among the labiatae oils, oregano oil has a high direct antioxidant potential, whereas rosemary potently induces antioxidant enzymes.

Aromex® ME and Pro, thanks to its unique blend of essential oils, has a high antioxidant power, as shown in a piglet trial performed in Nanjing Agricultural University (China), shown in Figure 4.

Antioxidant effects have positive consequences in animal health and final product quality: they may improve the dietary nutrient value and lead to a better oxidative stability and longer shelf life of fat, meat and eggs (Franz et al 2010).

Reduced ammonia emission

Ammonia is one of the main emission gases from livestock production. It negatively affects the environment, human and animal health by damaging respiratory epithelium, making the animal more susceptible to infections. Moreover, ammonia enters into the blood and requires detoxification. The reduction of ammonia emission in Aromex® Pro is achieved by:

- Nutritional effects: increased protein digestibility, resulting in less protein available at large intestine and better protein utilization (improved N balance)
- Saponin effects: Inhibition of ammonia formation, reducing activity of proteolytic bacteria at large intestine, ammonia binding and inhibition of urease activity.

As an average, supplementing pig diets with 100ppm Aromex® Pro, ammonia emission is reduced by 20-25 percent depending on BW range of growing-finishing pigs (Table 1) and ventilation rate as key variables at optimal crude protein content in the diet.

Costs and Return of Investment

The economic benefits when improving FCR by 2.5 percent (from 2.57 down to 2.50) in growing-finishing pigs (BW 20-107kg), using average feed costs of 254 €/MT, and assuming 4 percent mortality and medication costs 2€/pig (commercial data from SIP Consultors, 3tres3.com, Mar 31, 2017), the margin per sow/year increases by 36€. This represents 4.60€ benefit per MT of growing-finishing feed. When to this improvement of 2.5% FCR, a reduction of mortality (1%) is also applied (from 4 to 3%) and reduced medications costs (from 2 to 1€/pig) -as average improvements of Aromex® Pro compared to a control diet- the margin per sow/year increases up to 64€ and the benefit per MT of feed is up to 9.2€. ROI may range from 2.5 up to 4.5 depending on the feedstuffs costs.

With Aromex® ME and Pro, Delacon is ready to bring the benefits that customers expect from a phytogenic feed additive in profitable and sustainable pig production.

Figure 1. Aromex® Pro improves ileal digestibility of crude protein and amino acids in pigs

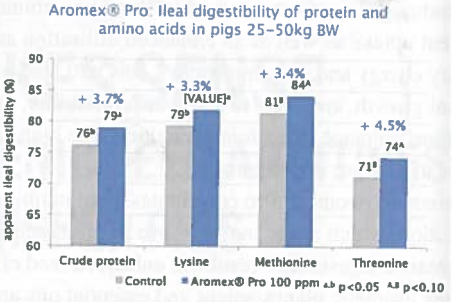


Figure 2: Aromex® Pro improves production performance in growing finishing pigs, summary of 7 trails.

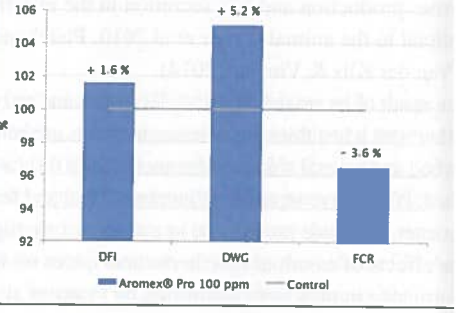


Figure 3. Aromex® Pro improves pig's body weight distribution

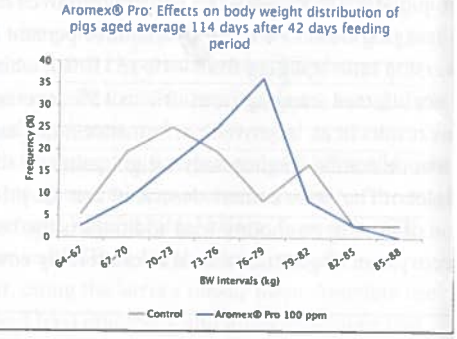


Figure 4. Aromex® increase anti-oxidant enzymes and decrease lipid peroxidation in piglets

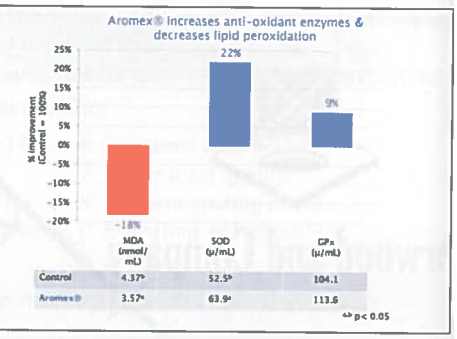


Table 1: Effect of Aromex® Pro on ammonia emission in growing finishing pigs, as measured in three experiments that were conducted in climate chambers at Delacon's Performing Nature Research Center.

	Trial 1	Trial 2	Trail 3
BW range pigs, kg	45-115	47-62	115-130
Diet[1]	12.9 MJ ME/ kg, 15.5% CP, 9.6 g d.lys/kg	13.8 MJ ME/ kg, 17.8% CP, 11 g d.lys/kg	13.7 MJ ME/ kg, 16% CP, 6.6 g d.lys/kg
Length of period of NH3 measurments, days	72	14	14
Reduction in Arommex PRO vs control diet	24%	25%	20%

[1]All diets were based on wheat, barley and soybean meal as major feedstuffs, and based on the ideal amino acid profile