

Formulating beyond nutritional norms for better carcass quality

Everyone connected with the swine industry has their own personal interest in carcass quality. Indeed, for consumers, the visual quantity of peripheral fat on the meat is a purchasing criterion.

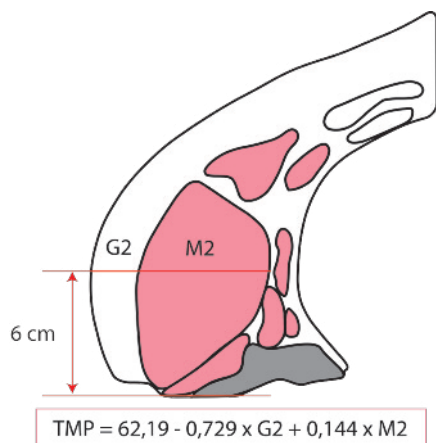
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Pig producers, in every country, are interested in decreasing their production costs, through better utilisation of the feed by the animal for example. And since the deposition of 1kg lean tissue in swine requires the use of around 5000 Kcal, while 1kg fat tissue has an average nutritional requirement of 9000 Kcal, animals save more calories by depositing muscle rather than fat; so the work on carcass quality gets interesting and profitable for farmers.

In some countries, farmers are even remunerated on enhanced carcass quality (for example, in France, G2 for back fat thickness, M2 for muscle, TMP for lean %, Fig. 1).

As for feed producers, their long term interest is to satisfy farmers in their demand for effective feed. Finally, abattoirs and pork processors look for best possible yield on the carcass, easier to process, with a

Fig. 1. Example of carcass quality measurement, France (G2, M2, TMP).



better homogeneity of lean proportion. The productivity of the slaughter and cutting equipment is also increased. Thus, more generally, muscle quantity (and protein quantity) impacts the profitability of the whole swine industry. It is also sustainable to produce more meat out of the same carcass, with the same resources.

Many parameters influence carcass quality. Genetics (muscle potential of boar lines, feed intake, precocity, etc), farm management and its related stress (temperature, type of floor, etc), sanitary conditions (respiratory, digestive pressure, etc) are important variation sources for back fat thickness and carcass quality (see Fig. 2).

Feed formula is also crucial; the first objective of nutritionists is indeed to design formulas that are the closest possible to nutritional requirements of the fattening pig at each stage of growth. They have to take into account its requirements in energy and amino acids for filling deposition of muscular proteins.

For instance, Idena nutritionists recommend an average of 3.5g digestible lysine/1000 Kcal net energy and from 0.84% (grower) to 0.78% (finisher) digestible lysine in the feed, depending on the context and raw materials available in the country.

Further to feed formula, feed quantities greatly impact carcass quality. It is the reason why some pig producers sometimes replace ad libitum systems by feed rationing, the challenge being not to penalise growth.

This conversion of feed quality and quantity into muscle is also highly dependent on other non-nutritional parameters.

The sex of the animals plays a central role; indeed, according to IFIP INRA Nathalie Quiniou 2007, the kinetic of feed consumption between females and castrated males varies more than 20% after 140 days, hence a higher predisposition of castrated males for back fat thickness.

The Image Meater (CBS System AG) developed by UNIPORC in France, shows that they produce more than 2.2mm back fat than females, and the difference increases with the weight, according to the database UNIPORC Ouest 2014. In parallel,

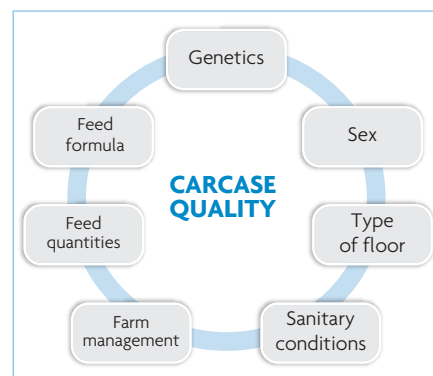


Fig. 2. Parameters that influence carcass quality in swine production.

females produce 3mm more muscle than castrated males, which leads to a major difference of the lean percentage between carcasses of each sex: 1.7 points (TMP). A challenge for the swine industry would be to decrease this difference between the sexes.

Faster fat tissue deposition after 60kg

Fat deposition is a major physiological constraint that occurs at finishing stages, while it is also the most crucial time for the margin on feed cost. It is the time when pigs produce extra fat, which penalises muscle. Indeed, after digestion, the use of feed nutrients by the animal is a mechanism of continuous flow. The use of amino acids and energetic sources (carbohydrates, LDL fatty acids) by the cells starts in the liver and continues for adipocytes 'supply'. However, the orientation of this flow differs according to the age and weight of the pig.

At the beginning of growth, the flow is orientated towards muscle deposition. It starts early and increases rapidly between 15-55kg. When hogs reach 60kg, a saturation level is reached, and other metabolism regulations force fat deposition and reduce muscle metabolism.

Indeed, the flow of nutrients is orientated towards accumulation in the adipocytes. Such physiological phenomena occur in

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 spite of technical adaptations such as feed formulation, precision feeding systems and farm management adaptations.

A trend to reverse

To reverse this metabolism, an exclusive Idena blend, made of the combination of enzymatic cofactors and plant extracts, has been developed (ValiMP). It is a nutritional speciality that orientates muscle deposition and limits fat tissues deposition of fattening pigs from 60kg live weight.

First, it avoids deamination of peptide chains and amino acids after absorption of these (deaminated) carbon chains, that would have decreased muscle deposition and lead to energy excess.

Moreover, ValiMP avoids excess fatty acids from the diet to accumulate inside the adipocytes, in order to limit the growth (and thus the volume) of fat reservoirs in the adipose cell (orientation of Acetyl-coA back to Krebs cycle and not in the production of fatty acids).

This pool of carbohydrate is especially high in ad libitum systems, where pigs eat fast and a lot. The carbohydrates in blood comes from the energy of the feed, and also from deamination of feed proteins.

This action of ValiMP on adipocyte differentiation has been observed in a complex model of pre adipocyte in vitro through:

- Less accumulation of lipids in the adipocytes with gradual concentrations of ValiMP (Fig. 3).
- The reduction of the gene expression for biomarkers of adipocyte differentiation (PPAR, CEBP, SREBP).
- Less expression of the genes that express fat accumulation inside the adipocytes (LPL, FABP that condition absorption of fatty acids in the adipose cell, or the growth of adipocytes).
- Phosphorylation or dephosphorylation of key enzymes that are implicated in lipid

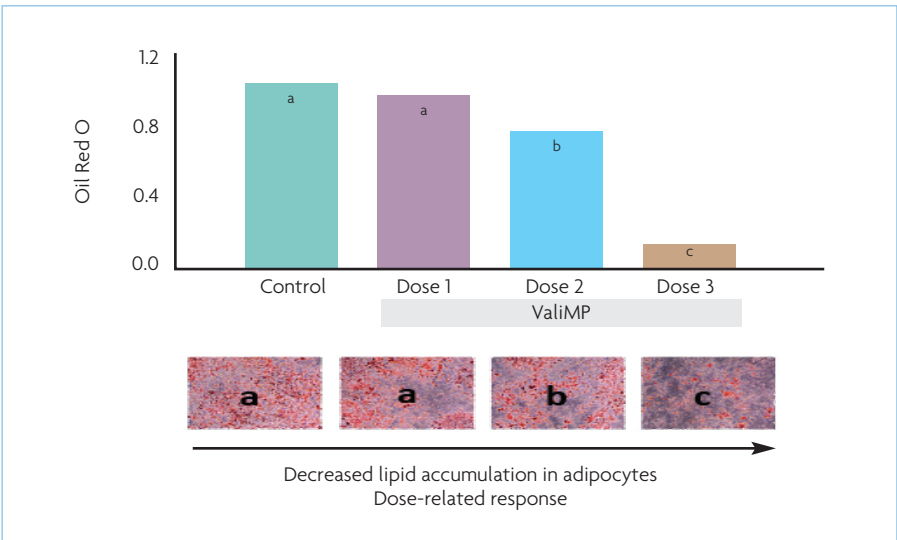


Fig. 3. Lipid accumulation by using staining Oil Red O, with different doses of ValiMP (In vitro trial, University of Korea). Representative picture of 3T3-L1 cells treated with 0.05, 0.1, and 0.2% of ValiMP during adipocyte differentiation. Oil Red O was extracted after staining, and then the concentration was measured at 595nm.

synthesis (deactivation of ACC and AMP).

Finally, ValiMP limits the mechanism of ‘fat storage’ in the liver (decrease of neolipogenesis) and regulates the fat accretion in the adipocytes.

Thus, the more nutrients in the feed (especially high energy formulas, in ad libitum systems), the better potential for ValiMP to produce lean meat, with better feed conversion ratio and daily gain; if used early enough before the start of adipocyte growth.

An established efficacy in ad libitum systems

The effects of ValiMP were investigated in various scientific and field trials. Two levels of measurements have been studied by Idena nutritionists: zootechnical performance on farm (growth, feed efficiency), carcass quality performance at

the slaughterhouse, with French and European carcass quality measurements: back fat (G2), muscle (M2), TMP (lean %), carcass ranking (E-U-R-O-P), etc.

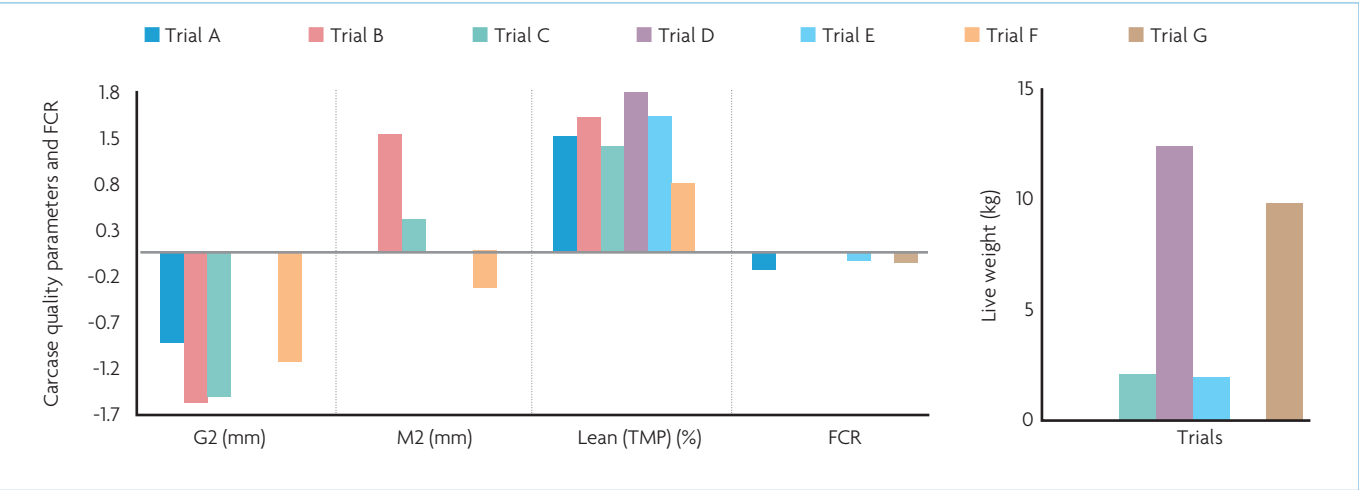
Results are compiled in Fig. 4. Thus, ValiMP enables heavier carcasses to be produced without degrading the ranking on muscle rate, for higher profit.

Confirmed efficacy in precision feeding

Obviously, such a large ‘pool’ of carbohydrates, from ad libitum systems, provide plenty of potential for ValiMP to prove its performance, as described in the compilation.

Thus, Idena nutritionists have designed a constraining experience at the IFIP (French National Institute of Swine), to verify the implication of ValiMP at metabolism level, once all formulation and digestion

Fig. 4. Compilation of performance of ValiMP versus control, in ad libitum systems.



parameters are ideal, in theory as well as on farm. Indeed, precision feeding enables the feed intakes to be adjusted to the theoretical nutritional requirements of each pig. It uses feeding in bi-phase adjusted to strict recommendations. Thus, two types of feeds are mixed, and their quantities are restricted and increased according to the weight of the pigs, in order to meet precisely the nutritional requirements of pigs at each day of growth.

In the constraining context of precision feeding, the effects of ValiMP were studied, on zootechnical and carcass quality performance of 48 pigs (24 castrated males, 24 females), in the restrictive context of limited feed consumption (precision feeding).

The following parameters were recorded at the day of slaughter, which was the same day for all pigs: zootechnical performance as individual weighing of each pig every three weeks, limited and precise feed consumption; and carcass quality data such as TMP (lean %), G2 (back fatness), and M2 (muscle).

Zootechnical performances are similar between both groups, which are expected, considering the restrictive context of limited feed consumption (precision feeding). However, carcass quality performance is higher in ValiMP group, which shows that ValiMP has an impact on metabolism, and not on digestion: +0.7kg carcass weight, +0.5 point lean % thanks to a decrease of back fatness G2 (-0.4) without reducing yield, and muscle increase M2 (+1.8).

The analysis of the results according to the sex enables the difference of the previous table to be explained. In females, we can notice an improvement of the performance in the ValiMP group with less back fatness and more muscle. In males, the performance is much higher in the ValiMP group, thanks to a strong increase of muscle and a decrease of back fatness. In both sex, yield is improved thanks to ValiMP (+0.4 point).

The supplementation of fatteners' feed with ValiMP enables carcass quality: +1.8mm muscle, -0.4mm back fat to be improved.

	Control group	ValiMP group
Weight at beginning (kg)	58.1	58.5
Slaughter weight (kg)	108.6	109.1
ADG (g/day)	870	873
Average daily feed intake (kg/day)	2.79	2.79
FCR finishing period	3.23	3.21
Carcass weight (kg)	86.5	87.2
TMP/lean (%)	61.7	62.2
G2 (mm)	12.4	12.0
M2 (mm)	59.0	60.8
Yield (%)	79.6	80.0

Table 1. Comparison of zootechnical and carcass performance according to the supplementation or not with ValiMP, in the restrictive context of precision feeding.

So, we can conclude that with ValiMP, castrated males get a similar carcass to females (see Tables 1 and 2).

Thus, ValiMP is a safe and natural feed additive that enables performance and profitability of pig producers to be improved by increasing the quantity of meat out of the carcass, thus producing more protein for human consumption.

The performance of ValiMP has been validated in the restrictive context of precision feeding. Its performance is even more probative in ad libitum systems,

where an average improvement of 1.2 point TMP (+€4.5/carcass on the French market) can be expected. It should be mixed in the feed at 2.5kg/ton from 60kg live weight to slaughter. ValiMP has no impact on the texture and quality of meat, only on its quantity through the volume of meat on the carcass. Idena works in parallel on organoleptic qualities of the meat.

More information is available on request contact@idena.fr

Table 2. Analysis detailed according to the sex of the fattening pigs, in the restrictive context of precision feeding.

	Control group		ValiMP group		Difference	
	Females	Castrated males	Females	Castrated males	Females	Castrated males
Carcass weight (kg)	87.9	85.1	87.8	86.7	-0.1	+1.6
TMP (%)	62.6	60.8	62.9	61.6	+0.3	+0.8
G2 (mm)	11.4	13.4	11.0	12.9	-0.4	-0.5
M2 (mm)	60.3	57.8	60.6	61.0	+0.3	+3.2
Yield (%)	79.7	79.5	80.1	79.9	+0.4	+0.4