Effect of early piglet nutrition and health on vitality and performance

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Feeding according to exact nutritional demands of piglets, most specifically piglets in the earliest stages of production, has increasingly gained focus over the past decades. In the meantime various feeding concepts have been specially developed worldwide for increasing weaning weight and vitality at weaning of piglets, simultaneously aiming for a decrease of pre-weaning and post-weaning mortality. This focused approach is widely supported by research literature repeatedly indicating early piglet nutrition and health to have a substantial influence on vitality and performance in later stages of pig production.

To dive into the essentials of piglet feeding demands an extensive knowledge of the raw materials, additives and ingredients involved in feed composition. Although there is a wide variety of additives available which – at a price – can assist in enhancing performance of piglet feeds, the very first concern when formulating those feeds should be the choice of the major raw materials.

Within each category of major raw materials (dairy, fats and oils, soy derivatives, cereals) there is a huge variety in quality, physical properties and nutrient specifications of products available.

The choice for a certain raw material for nutrition of highly demanding young piglets will depend on a series of criteria, not only including price and availability, but even more origin, digestibility, performance and feed safety. Therefore, to properly assess raw material quality for these important criteria, extensive additional knowledge about the processing with concern to the production of the available raw materials is a truly essential precondition.

Not least because of the above mentioned, formulation of feed for piglets up to 25kg of live weight has more and more developed into a specialist activity. This article will highlight some of the aspects which guide the important basic choices that have to be made when formulating piglet feed.

Basic considerations

From the earliest stages, feeding of piglets should be aimed at maximising feed intake to allow a better maintenance of gut health, improve future feed conversion rates and subsequently long term performance.

During the suckling period, the early intake of a special creep feed simultaneously with drinking sow's milk will improve technical performance after weaning, both measured by feed consumption and weight gain after weaning. Such a creep feed should be specially formulated with an eye for the specific demands of very young piglets for highly digestible sources of the basic nutrients. According to in-house research, switching (too) early to more economical, but less digestible, feeds will have a detrimental effect on intake, weight gain, feed conversion and often even on mortality up to at least five weeks after weaning.

Particle size	Prestarter (micron)
Average	500-600
100%	<2,000
At least 85%	<1,000
Not more than 10%	< 100

Table 1. Recommended particle size for feeds formulated for piglets up to the age of 14 days after weaning.

Choice criteria

Formulating specialty feeds for each specific age group of piglets, dedicated to their demands, primarily requires extensive knowledge and a sound and well considered choice of raw materials. With respect to the above mentioned factors, the price of raw materials should never be the one and only concern. Extensive research, preferably by

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Fig. 1. NPN content of dairy raw materials.

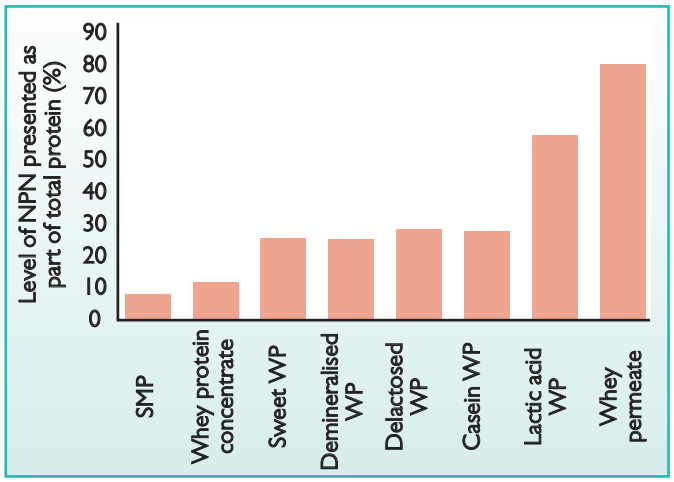
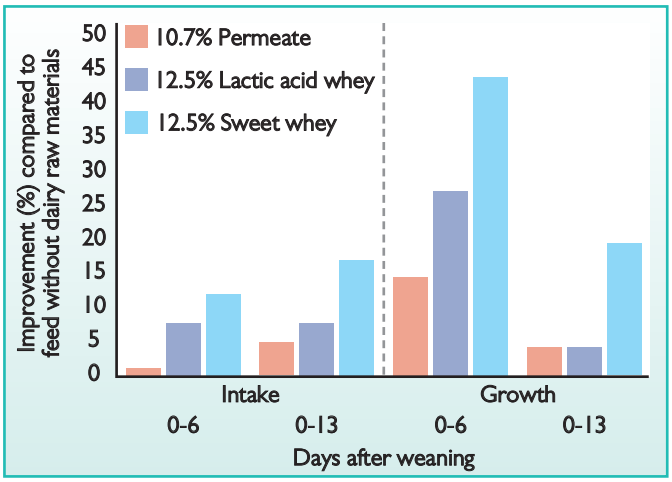


Fig. 2. Choice of whey type influences performance of piglets.



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performing digestibility trials, proves to be of utmost importance to acquire this explicit knowledge and to base a choice of raw materials on all the right criteria.

From this research for each of the major raw materials (dairy, fats and oils, soy derivates and other vegetable protein sources, cereals) one should obtain major guidelines with regard to important selection criteria and relevant potential hazards.

Dairy raw materials

Raw materials derived from milk processing like production of butter and skimmed milk powder (SMP), or cheese and whey outline a very complex group, widely differing in physical properties and nutrient specifications. The types of processing can be hugely different, resulting in a variety of products which, although sometimes equally named, show different levels of acceptance and performance in animal feed.

Although SMP is much appreciated as a dairy protein source, its protein content relies heavily on casein and less on whey protein. Protein in whey powder, derived from cheese production, completely consists of whey protein. Contrary to casein, whey protein includes valuable components like immunoglobulins and other bio-active substances.

When selected with care, whey powder and some of its derivates in piglet feed formulations often outperform SMP products in trials. However, one should be aware of differences in quality between different whey powders and whey derivates due to considerable variability in processing.

Depending on processing, whey products may contain low to substantially high levels of the less desirable non protein nitrogen (NPN), like urea and biogenic amines (see Fig. 1).

In sweet whey powder for example, up to 20-30% of the calculated protein level will originate from NPN, in lactic acid whey powder this will be 50-60%. Both products may be claimed on a label to be whey powder, although for use in piglet feed there is a clear difference in nutritional value (see Fig. 2). Depending on other techniques, the level of lactose in whey derivates will also vary. The same counts for ash levels, unavoidably influencing taste.

The choice for the right origin and quality of dairy raw materials therefore depends on the capability of feed producers to distinguish between all different types and sources of milk powder and whey products.

Furthermore, one should be constantly aware of the hazards arising from potential contaminations with preservatives, antibiotics, glucose and other substances as has been proved in recent history.

Fats and oils

The taste and palatability of piglet feed is to a vital extent determined by the choice of fat sources. Refining of fats is most important to remove disturbing factors like free fatty acids and contaminants.

For young piglets, fats not only play an important role in initiating the intake of dry feed, but, dependant on digestibility, also determine subsequent feed intake. Sufficient knowledge from digestibility trials about how fats are digested in the animal and regarding the effect of emulsification on fat digestibility is essential to properly assess the contribution of fats to the diet.

The properties of fats and oils, mostly consisting of triglycerides, again differ widely, depending on several features. Free fatty acids have a typical smell and reduce intake and digestibility. The degree of oxidation (storage!) determines palatability as well.

A peroxide number below 3meq/kg is considered to be safe, but does not give an indication of possible previous deviation. Chain length of fatty acids will have an effect on digestibility and their potential role in protecting against pathogens in the gut. The position of double bonds and the balance in the feed between the different types of essential fatty acids (Ω3 and Ω6 fatty acids) are important for the regulation of the immune system by balancing the build-up of (anti-) inflammatory precursors in the body. The melting point will influence the physical properties of the fat content in feed formu-

lations. Fats with a higher melting point (> 40°C) may be easier to process in mash diets, but have a worse digestibility. High moisture content (> 0.1%) will result in turbidity of fat, indicating a higher risk for oxidation. Last, but not least, choosing recycled or waste fats instead of edible fats and oils can have grave implications, because of the potential consequences for the human food chain.

Vegetable protein sources

There are numerous processes involved in production of soy derivates, all leading to differently specified potential soy protein sources. Dehulling, drying, toasting, milling fermenting and extrusion in the end determine trypsine-inhibition level, particle size, protein level, digestibility of protein and palatability, all at a certain price to quality ratio. Distinguishing objectively between various products is virtually impossible without performing digestibility trials in which growth, feed intake and feed conversion are monitored. And although more or lesser advanced types of processing may well improve specifications of some products on paper, their higher price is not always justified by technical results in trials.

A main criterion to choose from vegetable protein sources is knowledge of how Anti Nutritional Factors (ANF) like trypsine-inhibition are managed during processing. Proper analysis is absolutely necessary to check this issue.

Potential vegetable protein sources, including yeast, potato, pea, soy, rice and wheat have a distinguishing, specific essential amino acid pattern. This, together with their specific ANF profile, limits the extent in which they can be included individually or in combination in piglet feeds without compromising performance.

Carbohydrate sources

Carbohydrates represent 60-80% of digestible dry matter in feed for weaned piglets. They are digested partly by enzyme digestion, mainly in the small intestine. However, part of the digestion of carbohydrates is also achieved by microbial fermentation in the hind gut. The balance between enzyme digestion and fermentation is most important in maintaining gut health and integrity and can be influenced by choice of carbohydrate sources.

Beet pulp, for example, will be fermented fast in the upper part of the large intestine, cellulose will not be fermented at all, or only in the hind gut. The choice between cereals and other carbohydrate sources and their ratio also determine intestinal passage rate and subsequently the consistency of the piglets' faeces.

Processing, like milling, extrusion and pregelatinisation, will influence digestibility by altering respectively particle size (see Table 1), reduction of ANF and by improving physical properties of feed compositions.

Extruded and pregelatinised cereals will improve the stability of liquid feed, which is particularly important in liquid feed compositions which are developed specially for small piglets.

Besides, one should be aware of the potential hazards of (over-)processing. Overheating during extrusion can lead to retrogradation, causing a substantial decrease in starch digestibility. Already at a level in which no discolourisation (darkening) has occurred in the product, Maillard reactions can cause a considerable decrease (up to 20-50%) of availability of protein (lysine) in the feed.

In conclusion, the necessity to be aware of which major raw materials are purchased to formulate piglet feeds, and to check from which source they originate, and what type of processing and handling they were subjected to, is the basic essential factor of piglet feeding. When aiming at a high and consistent feed intake of a vastly susceptible group like piglets, those major raw materials are a first concern.

Only if this precondition has been met, together with safeguarding a balanced premix of vitamins, minerals and trace elements, may a selection of secondary special ingredients (organic acids, yeast extracts, essential oils, enzymes, etc) serve to further fine tune the feed composition. ■