



Bioactive dairy for optimal weaning

Because the intestinal barrier of a young piglet is not fully developed at weaning and active immunity is low, the piglet is at high risk for intestinal diseases after weaning. Health problems and low feed intake after weaning will lead to long-lasting damage of the intestine and lower performance up to slaughter. Dairy-based ingredients with bioactive components can help to support health and growth in this critical phase of life.

Weaning in pig production systems occurs much earlier and more abrupt compared to weaning in nature. This abrupt change leads to disturbances in the digestive system and the intestinal micro-flora. Together with an underdeveloped immune system and insufficient acid secretion to prevent pathogens from passing the stomach barrier, pathogens are enabled to enter, proliferate and cause intestinal malfunction in the gut.

Strengthen the intestinal barrier

A strong intestinal barrier can hinder the intraluminal passage of foreign antigens, pathogens, and their toxins. Especially with the reduction on antibiotics, zinc and copper, it is key to use as much as gut health mediators as possible, and the more natural the better... So why not

Table 0: components in milk with antimicrobial, immunomodulatory and anti-inflammatory action

IMMUNOGLOBULINS	PROVEN MODE OF ACTION	REF.
IMMUNOGLOBULINS	Antimicrobial action in intestinal lumen; anti-inflammation; support gut barrier function; immuno-modulatory	1-3
LACTOFERRIN	Antioxidant; antimicrobial; anti-inflammatory; prebiotic; stimulation intestinal cell proliferation	4-6
LACTOPEROXIDASE	Antimicrobial	4
LYSOZYME	Antimicrobial	7-8
β -LACTOGLOBULIN	Derived peptides have antimicrobial, anti-hypertensive antioxidative, immunomodulatory activity; inhibition of microbial adhesion; support digestion of milk lipids by enhancing activity of pre-gastric lipase	9
α -LACTALBUMIN	Derived peptides have anti-microbial and anti-hypertensive activity	9
GLYCOMACROPEPTIDE	Antibacterial; prebiotic; immunomodulatory; modulator of digestion and metabolism	4; 10-12
MILK FAT GLOBULE MEMBRANE	Antimicrobial; anti-inflammatory; prebiotic; Intestinal maturation; immunomodulatory	13-14

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use bioactive molecules that are present in milk. It is known from literature that these molecules support maturation of the intestinal barrier.

Bioactive value of milk-derived powders

It is well known that sow milk is crucial to nourish and protect the newborn piglets. But also in weaner diets, lactose and dairy protein are high value nutrients, used to increase feed intake and digestibility.

Furthermore, besides these macronutrients, milk contains more (micro) components, that are known to improve health, because of antimicrobial, immunomodulatory and anti-inflammatory actions (see table 0). These molecules will support piglets' gut health especially in stressful periods like weaning.

Not all dairy is the same

However, dairy powders (i.e. milk powder, whey powder, whey protein concentrate (WPC)) all originate from different processing plants in the food chain, and the different processing steps will alter the protein quality and bioactive properties. It is therefore Nukamel's role to select the dairy powders with the mildest treatments and therefore the highest digestibility and bioactive function. These powders will support the piglets' health more, and this will result in better animal performance.

Whey derived from casein production originates from a different process compared to cheese whey. In casein production, inorganic acids are added to precipitate the casein and thus separate the whey protein. However, this will also reduce the whey protein quality and lead to an inferior taste. On the other hand, in cheese production, whey is separated from the curd without

addition of inorganic substances, resulting in a higher quality product. For this reason, we only use cheese whey, guaranteeing a higher protein quality and a better taste.

Heat reduces nutritional value

Moreover, high heat treatments or multiple treatment steps lead to protein denaturation and possibly protein aggregation, which will reduce the nutritional of the protein. Heat will enhance Maillard reactions between (the carbonyl group of) lactose and free amino groups of milk proteins or amino acids, resulting in large Maillard-reaction-products which cannot be digested anymore by the animal. Protein digestibility of high-heat treated milk powders can therefore be significantly lower (Nunes et al. 2019).

Heat reduces biofunctionality

Next to the reduction of nutritional value, heat will also reduce the biofunctionality of whey proteins. Brick et al. (2017) compared the native whey proteome between raw cow's milk and milk after different industrially applied processing methods. They found that the most intensive heat treatment led to a 50% reduction in functional proteins, with less intensive heating also leading to considerable losses. Moreover they identified the specific whey proteins that were reduced by heat, and the majority of these proteins were related to immune functions. Among the most studied proteins were lactoperoxidase and lactoferrin.

Besides heat, also other processing steps like fat separation or fat homoge-

nization indirectly affects the proteome because the surface layer of fat globules are covered with milk proteins. It is therefore clear that the bioactive value of highly processed powders can be lower.

Feed versus food

For food applications, the bioactive and nutritional value are in general not of concern, but instead an extended shelf life or structure properties like viscosity, gel-formation and stabilization of matrix, are of interest. On the other hand, the purposes in the feed industry are very different. Especially for young animals, Nukamel aims for those dairy powders with the highest digestibility and bioactivity to optimize the animals' growth and health.

Critical selection of dairy by Nukamel

Because of the extreme variability in dairy powders on the market, Nukamel defined specific parameters to investigate quality of dairy ingredients further than solely nutrient composition. One of these parameters is the level of active immunoglobulins in whey powders. Besides its antimicrobial action in the gut, a high level of active Ig's is an indicator that other bioactive proteins are also preserved during processing.

We strongly believe that these quality differences reflect on the animal's performance. This was proven in a calf trial where significant differences in growth and feed efficiency were seen when using low heat-treated milk powder or high heat-treated milk powder in the calf milk replacer. Now, also a piglet trial proves that the choice of dairy ingredients in weaner diets can drastically affect piglet performance.

Nukamel chooses highest digestibility and bioactivity

cheese whey: higher protein quality and better taste

Table 1: Treatment groups

Two treatments were tested, Nukamix WPC vs. Food-grade WPC included in a weaner diet.

TREATMENT	Weaning (21d) + 2 weeks Weaner diet	Following 5 weeks Starter diet
NUKAMIX	5% Nukamix dairy protein	Same starter
FOOD-GRADE WPC	5% WPC protein	Same starter

Nukamix extra vs. Food-grade WPC

The difference between two dairy protein sources on piglet performance was tested at trial facility Innsolpig (Aalter, Belgium). Exactly the same amount of dairy protein was included in both treatment diets, but one source was selected by Nukamel's criteria, while the other was a food-grade WPC source which did not meet Nukamel's standards.

WPC is much appreciated in weaner diets because of its high quality protein, but this foodgrade WPC contained an amount of active IgG's high quality standards, but this foodgrade WPC contained a too low amount of active IgG's to be approved by Nukamel (<1% of total protein).

Besides the dairy ingredients, the other ingredients in the diets (barley, wheat, toasted soybean meal, soya oil, ...) were formulated as similar as possible, and the diets were optimized to identical nutritional values. Table 2 demonstrates that wet chemical analysis results were similar between weaner 1 and 2.

In the following 5 weeks, the same starter diet was provided to the piglets. This starter included Nukamix 10 as a

source of 6% lactose and a small but relevant inclusion of 1% dairy protein, for extra support.

Two weeks post-weaning, the piglets that were fed the weaner diet with Nukamix were on average 342 gram heavier, had eaten 283 gram more, and had a better FCR, compared to the piglets fed the diet with FG WPC (see table 3). This result clearly shows that choosing for Nukamix protein sources around weaning will improve piglet performance.

The following five weeks, all piglets received the same starter diet. At the end of the nursery, the nukamix group had the highest average body weight, although the difference between the two groups was smaller than at two weeks post-weaning. This is probably a result of limited feeding space in the pens at the end of the nursery.

It is expected that this could be a result of limited feeding space in the pens at the end of nursery, because it was observed that water intake was not increasing as much as expected in the last week

of the nursery (measured daily per pen, data not shown). Since daily water intake is correlated with daily feed intake, it is hypothesized that piglets would have eaten more and weight gain would have been higher in this last week, when there would be more feeding space available.

Eventhough the starter diet was the same between the two groups, the FCR in this phase was better for the Nukamix group. This shows a carry-over effect of the protein quality difference that was applied in the weaner diet. Offering a higher protein quality with bioactive function right after weaning, will lead to a better gut support in this critical period, resulting in an improved feed efficiency later in life. Better gut support was also shown in the health of the piglets. Mortality, diarrhea incidence and antibiotic treatments are indicated in Table 4 on the next page.

higher protein quality right after weaning, leads to better gut support

The occurrence of diarrhea was recorded daily during 7 days after weaning, and was highest on day 5 and 6. Diarrhea incidence on these days is presented in table 4 as the number of watery feces (heavy diarrhea) per total number of piglets, and this was lower for the Nukamix group. In addition, less antibiotic treatments needed to be given to the piglets receiving nukamix.

Treatments during the two weeks

Table 2: Chemical analyses on weaner diets 1 and 2, and the starter diet

FEEDS	HUMIDITY	PROTEIN	FAT	LACTOSE	ASH	FIBER	STARCH
WEANER 1. NUKAMIX	8,5	16,3	9,1	13,5	5,2	3,1	31,5
WEANER 2. FG WPC	8,1	16,2	9,2	13,6	4,6	2,9	31,9
STARTER	11,3	17,8	5,7	6,0	5,0	3,8	31,7

Table 3: Table 3: Performance results of two groups of piglets: 16 piglets x 8 pens per treatment.

	LS-MEAN		SEM	P-VALUE
	NUKAMIX	FG WPC		
BW AT WEANING (kg)	5,874	5,874		
BW 2 WKS POST-WEANING (KG)	7,298	6,956	0,093	0,013
FEED INTAK WEANER DIET (kg)	2,628	2,345	0,062	0,002
FCR WEANER DIET	1,90	2,39	0,221	0,128
BW 7 WKS POST-WEANING (KG)	21,470	21,333	0,369	0,794
FEED INTAK STARTER DIET (kg)	19,407	20,527	0,577	0,178
FCR STARTER FEED	1,37	1,43	0,026	0,137
FCR TOTAL PERIOD	1,42	1,48	0,025	0,075

Data are presented as least square means and the pooled standard error of the mean (SEM). All data were corrected for body weight at weaning (one-way ANOVA). P-value < 0.05 indicates a significant difference between the treatments, P-value < 0.10 indicates a near-significant difference.

post-weaning were mainly given against Escherichia coli (Lincospectine) except one against Streptococcus suis (amoxicillin). In the starter phase, all treatments were against S. suis. Besides the improved performance in the immediate post-weaning phase, also the overall health data prove that Nukamix ingredients are the better choice when using dairy ingredients around weaning.

dairy protein sources aiming for the best piglet performance and health. In a complex and highly variable dairy market, in which the food industry determines the quality of the dairy powders that will end up in animal feed, it is Nukamel's focus to select the best sources for young animals, to offer the best start of growing.

If you would like to learn more, please contact Jan Druyts:

To conclude, Nukamel critically selects [+31 \(0\)495 541 165 | jan@nukamel.com](mailto:jan@nukamel.com)

Table 4: Health status of two groups of piglets. 16 piglets x 8 pens were monitored per treatment.

	NUKAMIX	FG WPC
MORTALITY %	3,13	4,69
DIARRHEA INCIDENCE % (DAY 5)	10,16	14,84
DIARRHEA INCIDENCE % (DAY 6)	0,00	1,56
AB TREATED PIGLETS % (2WKS)	3,91	8,59
AB TREATED PIGLETS % (5WKS)	2,34	6,30

health status demonstrates the benefit of using a top quality dairy protein source.

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