Nukamel

Volamel

A true nutritional emulsifier

The (st)art of growing

Volamel Extra

- The most hydrophilic emulsifier in the market
- Improved fat digestion
  - Efficient growth
  - Lower feed conversion
  - Increased profitability
- Part of today's top nutrition, animal health approach and strategy towards antibiotics reduction
- Better protein solubility and digestibility

CERTIFIED the art of growing

FAT DIGESTION: A COMPLEX PROCESS

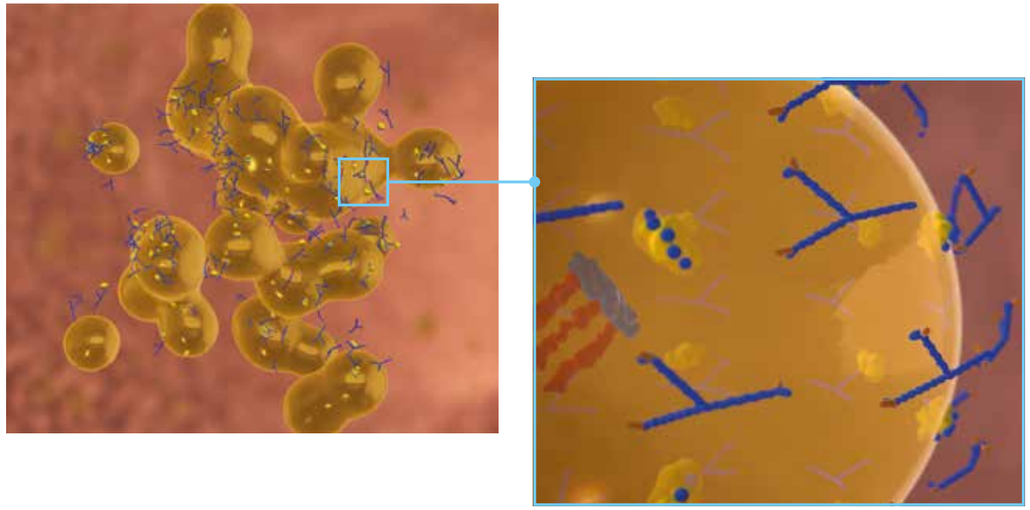
✔ **Volamel Extra enhances the digestion of fat, fat-soluble vitamins and other nutrients**

The absorption of dietary fats and oils by young animals is limited due to the immaturity of the digestive system, resulting in inferior feed efficiency and loss of expensive energy.

IMPROVED EMULSIFICATION

✔ **Improved emulsification of fat droplets in the aqueous environment of the gut**

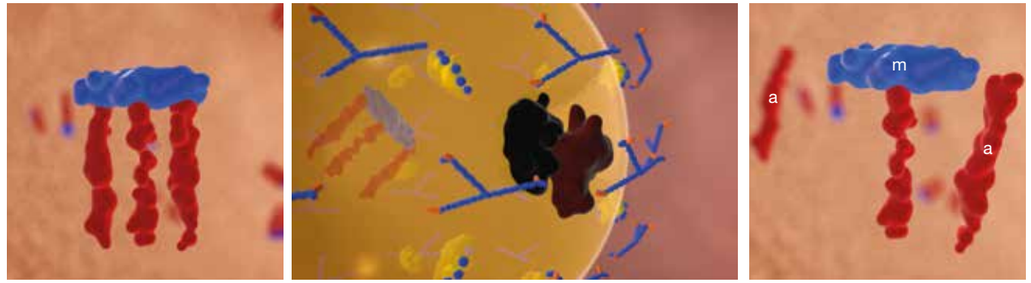
Synergy between Volamel Extra and natural bile salts.



HYDROLYSIS

✔ Hydrolysis of triglycerides by pancreatic lipase

Breakdown of fat into a mixture of fatty acids and 2-monoglycerides.



Triglyceride | Pancreatic lipase | Free fatty acids (a) and 2-monoglyceride (m)

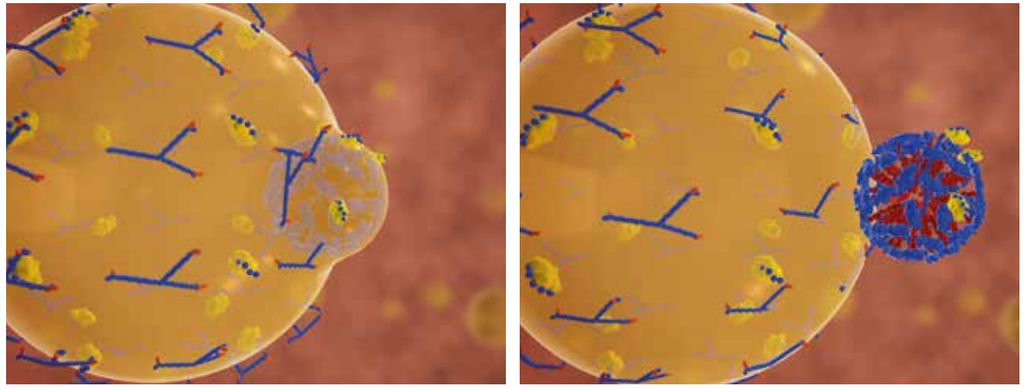
MICELLE FORMATION AND ABSORPTION

✔ Improved formation of mixed micelles with inner lipid core

Synergy between Volamel Extra and natural bile salts.

✔ Enhanced absorption of fat by epithelial cells

Fatty acids and monoglycerides are transported to the surface of the enterocytes for absorption.

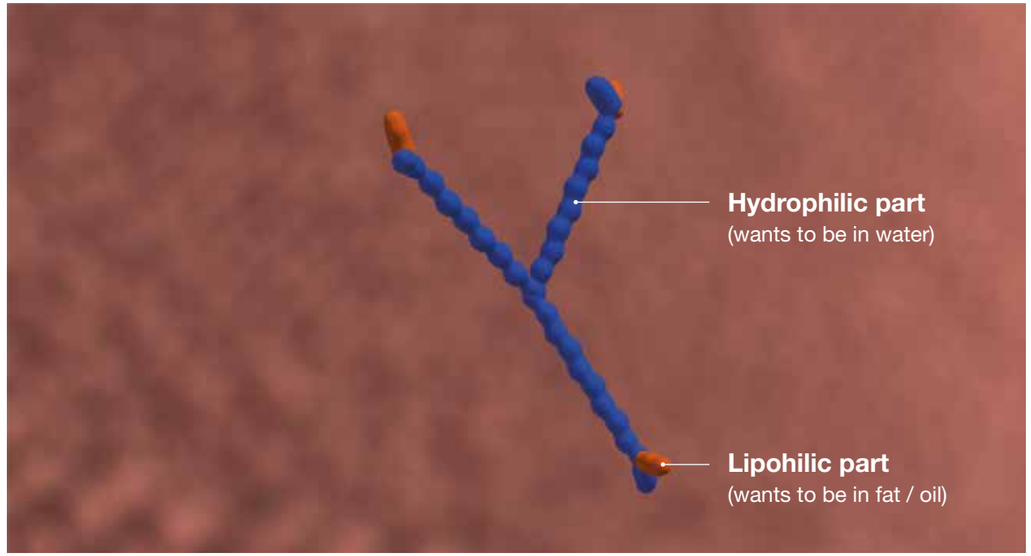


PEGR BASED PRODUCT

Volamel Extra is a glyceryl polyethylene glycol ricinoleate (PEGR) based product (20%) on a nutritional carrier of vegetable and whey proteins.

✔ An emulsifier has hydrophilic and lipophilic parts

Acts on the surface border between water and oil.



HYDROPHILIC NATURE

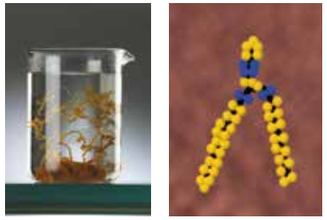
✔ Hydrophilic-to-lipophilic balance

Volamel Extra is extremely hydrophilic (HLB ~18) and dissolves in the watery environment of the gut.

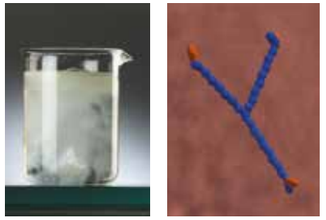
✔ A bird consumes 1,5 to 2 times more water than feed

The gut is a watery environment with a little amount of fat present, thus an oil-in-water (o-w) emulsion.

w-o emulsion



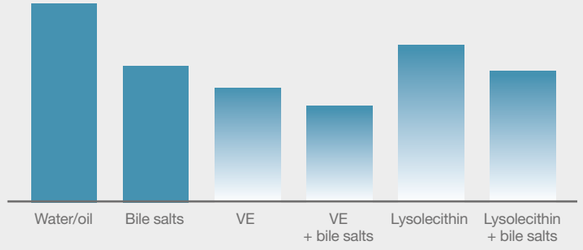
o-w emulsion



HIGH STABILITY AND SYNERGY WITH BILE

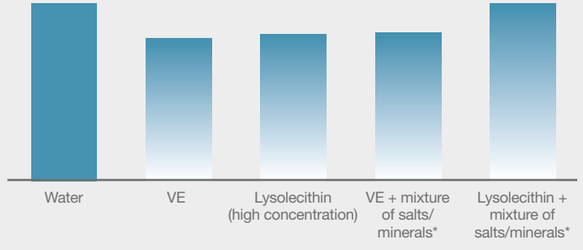
Volamel Extra is a non-ionic nutritional emulsifier, stable in broad pH range and at high temperature (suitable for use in pelleted feed).

INTERFACIAL TENSION (mN/M)



Volamel Extra is a very potent emulsifier that reduces the interfacial tension significantly. Moreover, in combination with bile, the interfacial tension is further reduced.

SURFACE TENSION (mN/M)

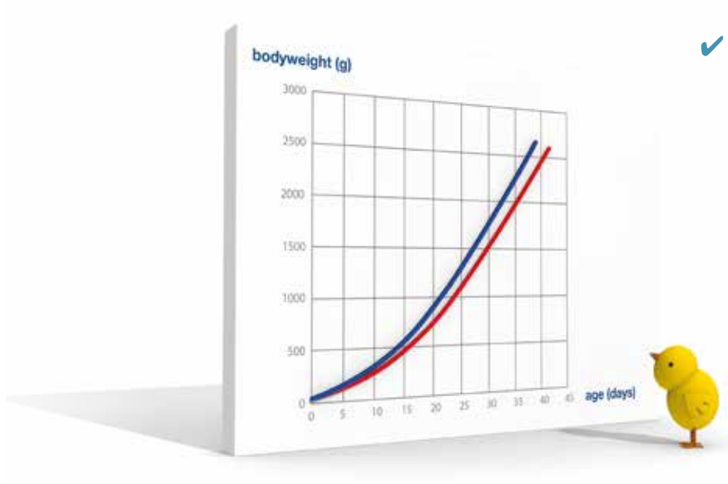


Volamel Extra is not influenced by salts or minerals in the intestinal tract, unlike (lyso) lecithins. *mixture of salts and minerals representing what is present in the gut.

BETTER PERFORMANCE

✔ Animal trials show a better performance and superior health status of young animals when using Volamel Extra

- Enhanced fat and protein utilization
- Improved body weight gain and feed conversion ratio
- Increased profitability and decreased feed cost
- Improved carcass and meat quality
- Shift to beneficial bacteria in the hind gut
- Less fat/protein excretion
- Higher energy intake in case of heat stress
- Decreased abdominal fat deposition and fattening of the liver



✔ Growth curve broilers

The relative importance of the first seven days after hatch has subsequently increased, with it now accounting for up to 20% of the broiler's life.

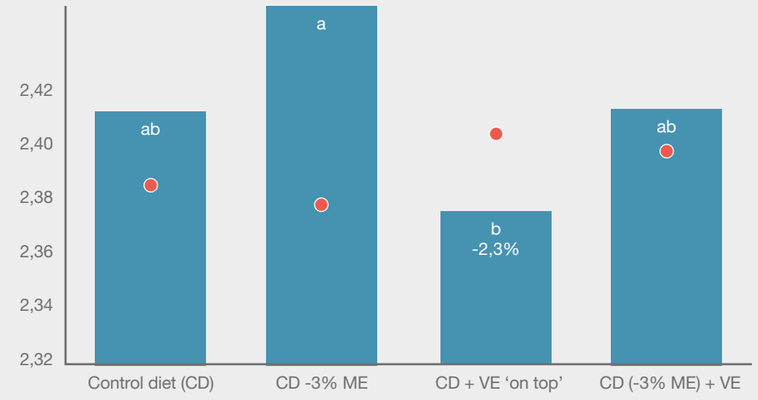
DOSAGE

Volamel Extra is added to feed at dosage rates of 250 to 500 g/MT

1 → On top: improve performance parameters and health

2 → Save energy, save cost: compensation of reduced energy in diet formulation

EFFECT OF VOLAMEL EXTRA ON BROILER PERFORMANCE
BW (●) AND FCR2000 DAY 42

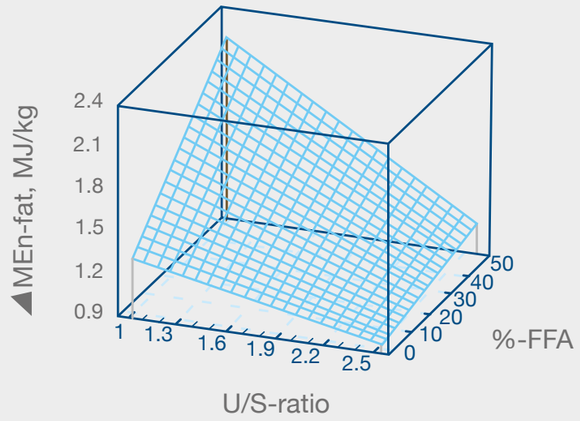


Catholic University of Leuven, Belgium (2004): commercial corn-soy based diet, formulated to standard requirements and with 3% reduction in ME (metabolizable energy). BW: Body weight; FCR2000: Feed conversion ratio corrected for 2kg broiler weights.

SAVE ENERGY, SAVE COST

- The energy-saving effect of Volamel Extra is more pronounced in case of
  - Lower ratio of unsaturated/saturated (U/S) fatty acids
  - Higher free fatty acid (FFA) content

AVERAGE ME BROILERS*: 220000 KCAL/KG



The effect of U/S & FFA on the in vivo efficacy of Volamal Extra in terms of δMEn-content of the added lipid. Broiler trail, University of Ghent, Belgium (2003). Wheat-soya based diet with 7,5% added fat - VE inclusion on top (500 g/MT).
** The ME is determined after analyzing the results of years of extended research in universities worldwide. An inclusion of 500 g/MT of Volamel Extra can compensate for about 3% of the energy of the feed. This can be translated into an energy content of 220000 kcal/kg product.*

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FAT SOURCES

TYPICAL FATTY ACID COMPOSITION (%) OF DIFFERENT FATS AND OILS

	SOYBEAN OIL	RAPESEED OIL[1]	PALM OIL	RICE BRAN OIL	LARD	TALLOW	POULTRY FAT
C14:0	-	1	1	0,5	1	2	1
C16:0	10	4	42	15	27	26	22
C16:1	-	1	-	-	2	2	7
C18:0	4	2	5	2	13	22	5
C18:1	23	55	40	45	45	42	40
C18:2	51	25	10	36	11	2	19
C18:3	7	10	-	0,5	-	-	1
U/S[2]	5,8	15,0	1,0	4,7	1,4	0,9	2,4

(1) Rapeseed oil: contains erucic acid (C22:1) (2) U/S ratio is (C16:1 + C18:1 + C18:2 + C18:3)/(C14:0 +C16:0 +C18:0)

ME VALUES OF VARIOUS OILS[3]

	BIRD < 3 WK	BIRD > 3 WK
Crude Soybean oil	8800	9060
Crude Rapeseed oil	9000	9260
Crude Palm oil	6740	7870
PFAD[4] (FFA=70%)	5340	7000
Rice bran oil (FFA=5%)	8700	8980
Rice bran oil (FFA=15%)	8480	8840
Lard	7110	8060
Tallow	5830	7300
Poultry Fat	8140	8620

(3) Calculated using Wiseman equations for birds of < or > than 3 weeks old (4) PFAD: Palm Fatty Acid Distillate.

✔ Besides the fatty acid profile other factors influence the ME value of fats and oils

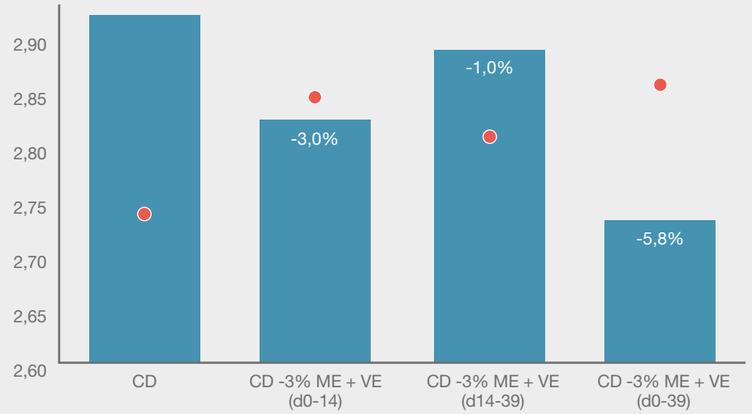
- Moisture, impurities and unsaponifiables (MIU) decrease ME and accelerate rancidity.
- Heating (+ air) results in the formation of non-digestible oxidation and polymerization products. (Poly)unsaturated fatty acids are specifically targeted. It affects flavor, color and texture, as well as destroys fat-soluble vitamins (e.g. E, A).

VOLAMEL EXTRA: FROM START TO FINISH

✔ High performing animals benefit from the addition of Volamel Extra from start to finish

- In (pre)starter periods due to immaturity of the digestive system.
- In grower/finisher periods as the level of nutrients can easily exceed the digestive capacity using high-density diets and achieving high feed intake.

EFFECT OF VOLAMEL EXTRA ON BROILER PERFORMANCE
BW (●) AND FCR2500 DAY 39



Catholic University of Leuven, Belgium (2013): wheat-soy based diet with animal fat and full-fat soybeans, formulated to standard requirements and with 3% reduction in ME (metabolizable energy) for starter (d0-14), grower (d14-39) or both. BW: Body weight; FCR2500: Feed conversion ratio corrected for 2,5kg broiler weights.

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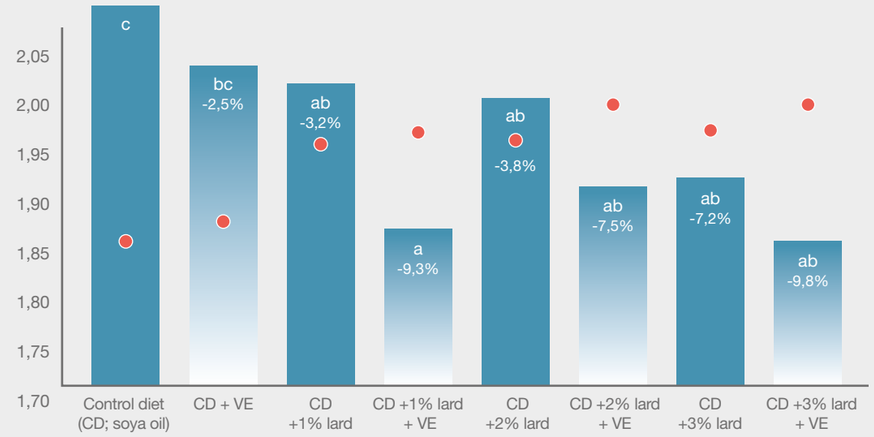
FROM LOW TO HIGH ENERGY DIETS

Volamel Extra is a cost-effective means to improve performance, even in case of lower fat levels and high U/S.

✔ Volamel Extra further optimizes the result. Adding higher levels of fat to broiler diets improves efficiency (extra-caloric effect)

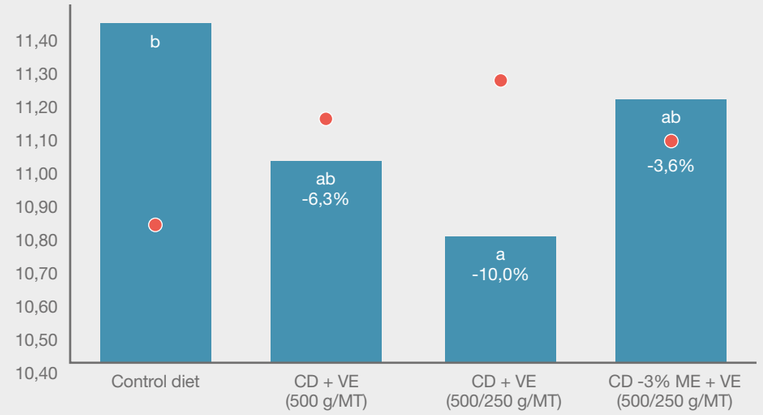
EFFECT OF VOLAMEL EXTRA ON BROILER PERFORMANCE
BW (●) AND FCR1800 DAY 35 - INCREASING ADDED FAT LEVEL



University of Warmia and Mazury, Olsztyn, Poland (2013): wheat-corn-soy based diet, starter diet formulated at 2,3%, 3,3%, 4,3% and 5,3% of added soya oil + lard, resp.; grower diets formulated at 3,4%, 4,4%, 5,4% and 6,4% of added soya oil + lard, resp. BW: Body weight; FCR1800: Feed conversion ratio corrected for 1,8kg broiler weights.

EFFECT ON TURKEY PERFORMANCE

EFFECT OF VOLAMEL EXTRA ON TURKEY PERFORMANCE
BW (●) AND FCR11000 DAY 116



University of Warmia and Mazury, Olsztyn, Poland (2012): wheat-corn-soy based diet formulated to standard requirements and with 3% reduction in ME (metabolizable energy). Volamel Extra was added at 500 g/MT during 16 weeks or at 500 g/MT during the 1st 8 weeks and at 250 g/MT during the 2nd 8 weeks. BW: body weight; FCR11000: Feed conversion ratio corrected for 11,0kg turkey weights.

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BETTER FAT DIGESTIBILITY AND LITTER

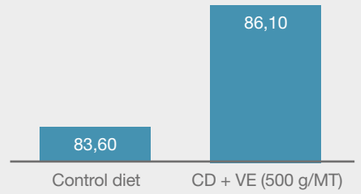
✔ Animal trials show increased fat digestibility and AME values when using Volamel Extra

EFFECT OF VOLAMEL EXTRA ON FAT DIGESTIBILITY (%) AND AME (KCAL/KG) IN BROILERS

AGE	CPO	CPO+VE	RBO	RBO+VE
d7	69,1	71,5*	72,0	79,1
d14	75,0	80,3*	82,6	84,8
d35	84,8	83,3	86,1	88,7
AGE	**CPO**	**CPO+VE**	**RBO**	**RBO+VE**
d7	2756	2970*	2948	3066
d14	2612	2748*	3059	2968
d35	3214	3361*	3289	3383*

*University of Putra, Malaysia (2015): corn-soy based diet formulated to standard requirements with CPO (Crude Palm Oil) or RBO (Rice Bran Oil). * P-value< 0,05*

EFFECT OF VE ON FAT DIG. (%) IN TURKEYS



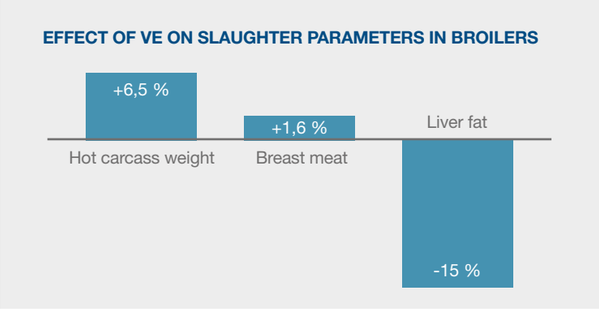
EFFECT OF VE ON OCCURRENCE OF STICKY VENTS (%) IN BROILERS

AGE	CONTROL	CD+VE
< 10 days	40%	15%
10-20 days	18%	0%

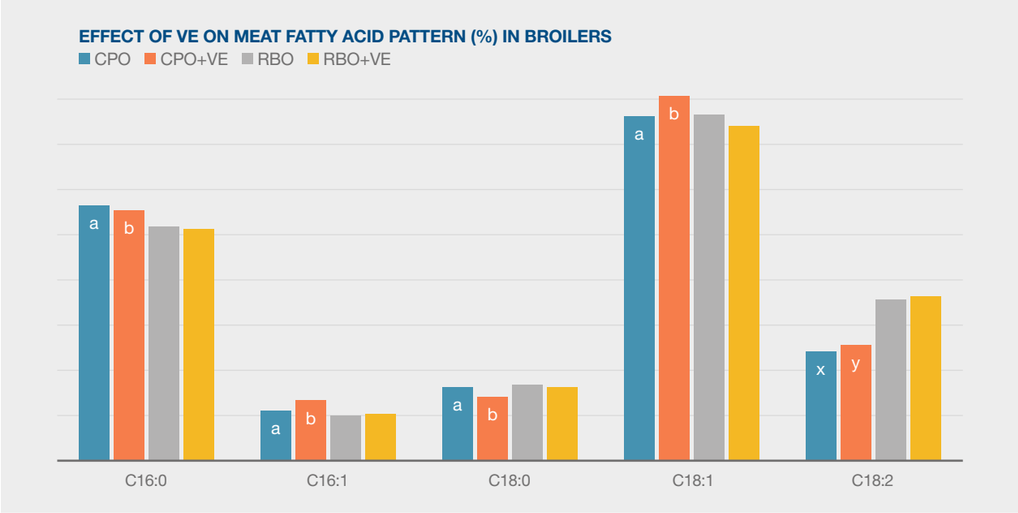
University of Bengal, India (2008): corn-soy based diet formulated to standard requirements with saturated dry fat.

SUPERIOR MEAT QUALITY

Carcass weights, meat quality and liver metabolism are positively influenced by Volamel Extra.



University of Bengal, India (2008): corn-soy based diet formulated to standard requirements with saturated dry fat.



University of Putra, Malaysia (2015): corn-soy based diet formulated to standard requirements wiyh CPO (Crude Palm Oil) or RBO (Rice Bran Oil).

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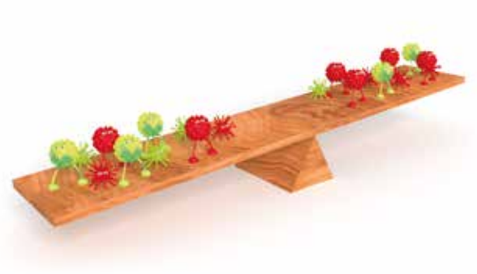
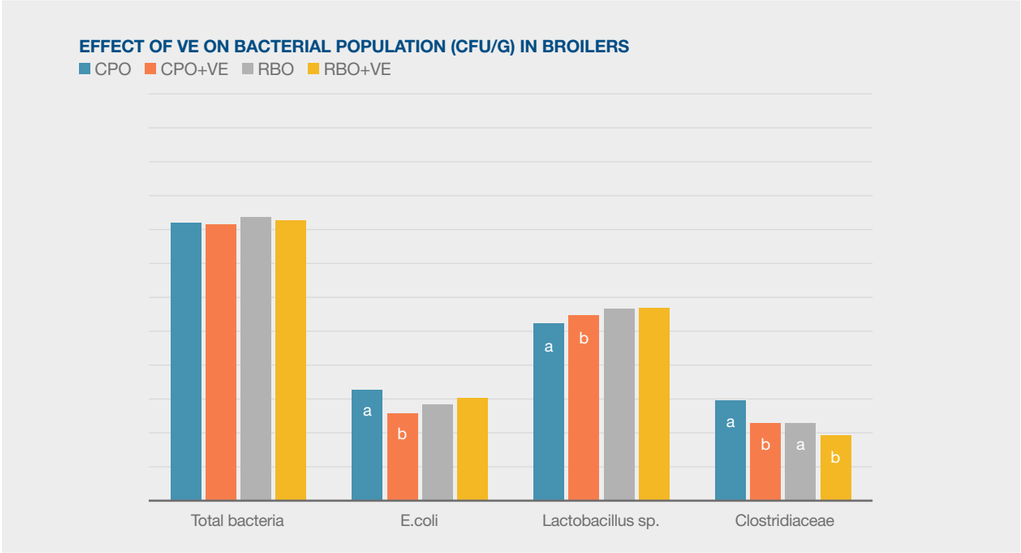
INTESTINAL HEALTH

Proper digestion and healthy condition go hand in hand. This can be seen from a positive influence of Volamel Extra on the bacterial population in the hind gut.

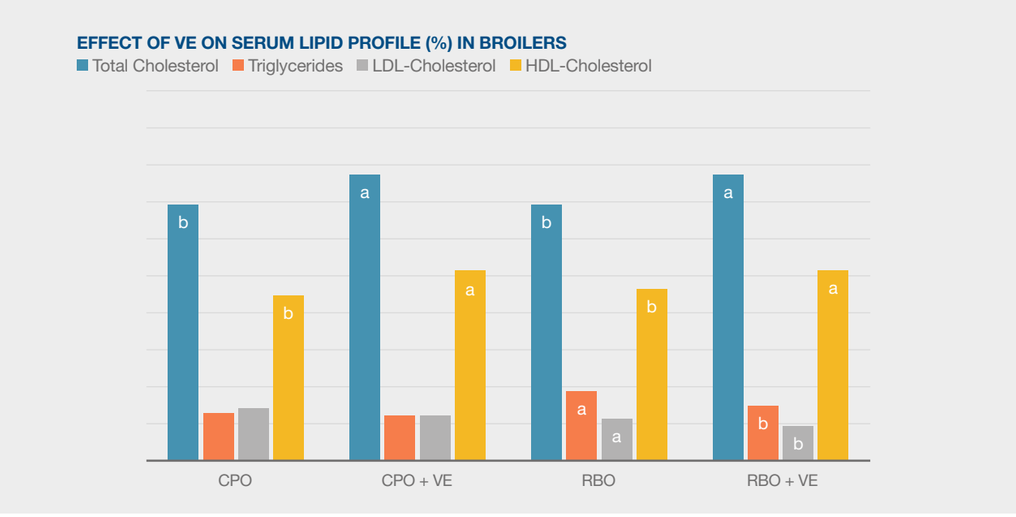




University of Putra, Malaysia (2015): corn-soy based diet formulated to standard requirements wiyh CPO (Crude Palm Oil) or RBO (Rice Bran Oil).

LIPID METABOLISM

- ✔ Lipid metabolism is positively influenced by the addition of Volamel Extra in the diet
- ✔ HDL cholesterol scavenges and removes ‘bad’ cholesterol from the blood



University of Putra, Malaysia (2015): corn-soy based diet formulated to standard requirements wiyh CPO (Crude Palm Oil) or RBO (Rice Bran Oil).

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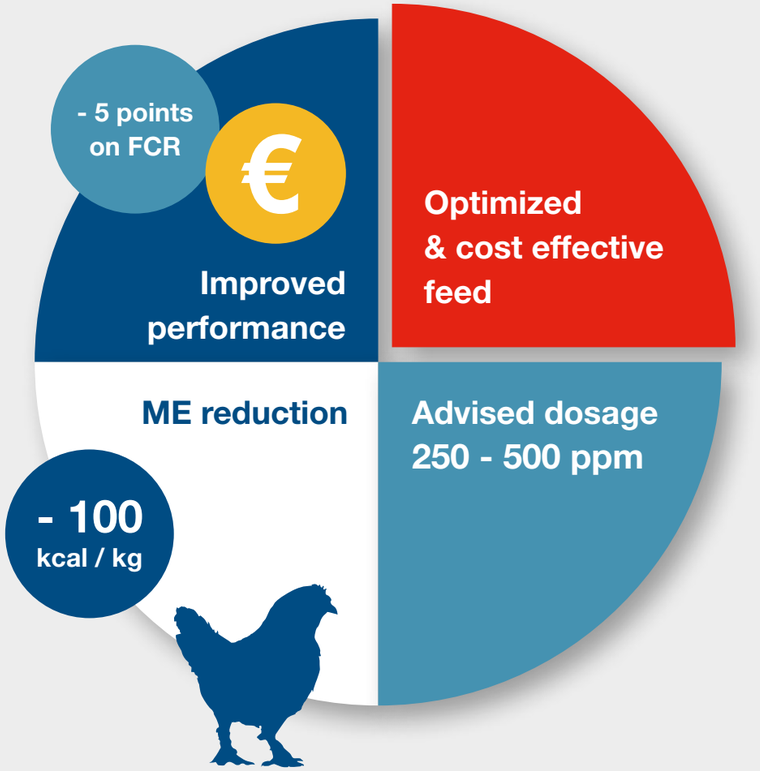
A true nutritional emulsifier

VOLAMEL EXTRA compensates ‘on average’ 3% of energy in the feed



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ADDITIONAL RELEASED AME IN FEED

✔ Additional AME (kcal/kg) released by emulsifier depends on diet composition:

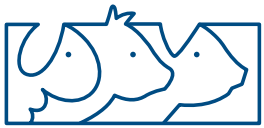
- Total level of fat in diet
- Ratio unsaturated / saturated fatty acids (U/S ratio)
- Level of free fatty acids (FFA)

LOW ENERGY DENSE DIETS ➜ ADDED FAT LEVEL ≤ 2%
DOSAGE VOLAMEL = 250-350 PPM

AME upgrade (matrix value) In kcal/ MT feed	High U/S	Low U/S
Low FFA	50	80
High FFA	70	100

HIGH ENERGY DENSE DIETS ➜ ADDED FAT LEVEL > 2%
DOSAGE VOLAMEL = 350-500 PPM

AME upgrade (matrix value) In kcal/ MT feed	High U/S	Low U/S
Low FFA	70	100
High FFA	90	120



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