FEEDING MANUAL

Feed manual for Topigs Norsvin Finishers

Topigs Norsvin Support & Development

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Title Feeding advice for Norsvin Duroc progeny

Reference
Feeding manual Norsvin Duroc progeny 2016

Target Group
Nutritionists and Farm managers

Explanation
Advice and guidelines on how to feed the progeny of the Norsvin Duroc Terminal boar

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1. Introduction

Topigs Norsvin works continuously towards progress in pigs. An important part of this progress is up to date feed manuals that will help our customers attain optimal production at herd level. To achieve this, estimation of daily nutritional requirements for energy and protein is essential. In addition, knowledge about factors that affect voluntary feed intake and/or performance of swine is needed when formulating diets.

Pigs have daily requirements for absolute quantities of specific nutrients. Topigs Norsvin estimates the daily nutritional requirement for energy and protein. Various factors affect voluntary feed intake and/or performance of swine, and thus will affect the concentration of nutrients that should be provided in the diet. Thus knowing the daily feed intake of the animals and understanding the factors involved, diet formulations can be adjusted accordingly to ensure optimal production at an economical cost.

2. Aim of the manual

The aim of this manual is to provide a feeding guideline based on the nutritional requirements of the Norsvin Duroc genotype to achieve an optimum genetic performance. Achieving the optimum genetic performance will result in optimal growth and minimal feed conversion ratio. However depending on the production system and market demands the feeding guidelines might not necessarily lead to the best economical results. Maximum lean growth can be achieved only when the nutrients, specifically amino acids and energy, are supplied in the diet at the appropriate amount.

3. Typology and characteristics of the Norsvin Duroc

Norsvin Duroc boar is known as the Topigs Norsvin Duroc line. Norsvin Duroc shows an exceptional genetic trend for lean meat percentage and feed efficiency, mainly due to the use of CT scan technology and FIRE stations for carcass quality and feed intake measurements. The qualities of the progeny of the Norsvin Duroc boar are:

- Superior feed efficiency
- Robustness
- Lean growth
- Unique meat quality

In order to benefit from its genetic potential, it is important to feed closely to its capacity.

4. Nutritional requirements

4.1 Basic assumptions

- Multi-phase feeding
- Animals fed *Ad libitum*
- Dry mash diet, with dry matter of 88 % (using pelleted feed improves the digestibility of the diet)
- Conventional health
- Sexes separately housed and fed
- Ideal ambient temperatures

4.2 Nutrient boxes

Nutrient boxes for all three sexes (Castrates, Gilts and Boars) are given in Section 5. The Nutrient boxes provide the producer and/or feed company with the dietary recommendations for each sex. Diets for the Norsvin Duroc's offspring need to be developed within the minimum and maximum nutrient recommendations. The minimum nutrient levels are more suitable for Wheat-Barley based diets and the maximum nutrient levels for Corn-Soy based diets. Independent of the raw material type, constant SID Lysine : NE ratio should be used between minimum and maximum.

4.3 Nutritional recommendations for Norsvin Duroc

Table 1. Daily nutritional recommendations and weight development of Norsvin Duroc finishers based on a 3 phase feeding program

Days in phase	Castrates			Gilts			Boars		
	BW, kg	NE, MJ/day[1]	Lys. SID, g/day[1]	BW, kg	NE, MJ/day[1]	Lys. SID, g/day [1]	BW, kg	NE, MJ/day[1]	Lys. SID, g/day[1]
1	25.0	12.4	13.6	25.0	11.7	13.2	25.0	12.1	14.5
8	29.5	15.2	16.6	29.3	13.7	15.5	29.5	13.7	16.4
15	34.6	17.2	18.8	34.4	15.5	17.6	34.7	15.2	18.2
22	40.5	19.2	21.0	40.0	17.2	19.5	40.3	16.6	19.9
29	46.9	20.7	19.2	46.0	18.4	17.9	46.3	17.7	18.3
36	53.8	22.0	20.4	52.4	19.8	19.2	52.7	18.9	19.5
43	61.0	22.9	21.2	59.3	20.9	20.2	59.4	20.0	20.6
50	68.5	24.0	22.2	66.4	21.9	21.2	66.5	21.0	21.6
57	76.4	24.1	18.4	73.7	22.0	17.9	73.8	21.3	18.6
64	84.2	24.7	18.9	81.2	22.8	18.5	81.3	22.2	19.4
71	92.1	25.3	19.4	88.8	23.6	19.1	89.0	22.9	20.1
78	99.9	25.7	19.7	96.4	24.3	19.7	96.8	23.6	20.7
85	107.6	26.2	20.1	104.1	24.9	20.2	104.7	24.3	21.3
92	115.2	26.7	20.4	111.9	25.5	20.6	112.7	24.9	21.8
99	122.7	27.2	20.8	119.4	25.9	21.0	120.7	25.4	22.3
106	130.3	27.6	21.2	127.2	26.4	21.4	128.7	26.0	22.8

[1] Net energy (NE) and standardized ileal digestible (SID) lysine requirements are expressed as the amount required per day.

5. Diet specifications

Table 2. Nutrient boxes for Norsvin Duroc offspring: **Castrates**

Castrates

Weight Range	Nutrients	Unit	WB[1]	CS[2]
25 – 45 kg	Ave Daily Feed Intake	Kg/day	1.62	1.58
	Net Energy	MJ/kg	9.8	10.1
	Metabolizable Energy	MJ/kg	13.2	13.6
	Metabolizable Energy	Mcal/kg	3.14	3.24
	Lysine SID	g/kg	10.7	11.0
	SID Lys/NE	g/MJ	1.09	1.09
	Calcium	g/kg	7.3	7.5
	Digestible Phosphorus	g/kg	2.7	2.8
45 – 75 kg	Ave Daily Feed Intake	Kg/day	2.25	2.24
	Net Energy	MJ/kg	9.7	10.0
	Metabolizable Energy	MJ/kg	13.1	13.5
	Metabolizable Energy	Mcal/kg	3.12	3.21
	Lysine SID	g/kg	9.0	9.3
	SID Lys/NE	g/MJ	0.93	0.93
	Calcium	g/kg	6.3	6.3
	Digestible Phosphorus	g/kg	2.5	2.5
75 - End	Ave Daily Feed Intake	Kg/day	2.74	2.67
	Net Energy	MJ/kg	9.4	9.7
	Metabolizable Energy	MJ/kg	12.7	13.1
	Metabolizable Energy	Mcal/kg	3.02	3.12
	Lysine SID	g/kg	7.2	7.4
	SID Lys/NE	g/MJ	0.76	0.76
	Calcium	g/kg	6.1	6.3
	Digestible Phosphorus	g/kg	2.4	2.4

[1] - Wheat-Barley based diets.
[2] - Corn-Soy based diets.

Notes

- Advised phosphorus levels are based on diets formulated without the use of Phytase. The use of Phytase implicates in the necessity of readjusting these phosphorus levels.
- NE = ME X 0.74 (The conversion factor could be different for each country).

Table 3. Nutrient boxes for Norsvin Duroc offspring: **Gilts**

Gilts

Weight Range	Nutrients	Unit	WB[1]	CS[2]
25 – 45 kg	Ave Daily Feed Intake	Kg/day	1.49	1.42
	Net Energy	MJ/kg	9.9	10.2
	Metabolizable Energy	MJ/kg	13.4	13.8
	Metabolizable Energy	Mcal/kg	3.19	3.28
	Lysine SID	g/kg	11.2	11.5
	SID Lys/NE	g/MJ	1.13	1.13
	Calcium	g/kg	7.9	8.3
	Digestible Phosphorus	g/kg	2.9	3.1
45 – 75 kg	Ave Daily Feed Intake	Kg/day	2.06	2.03
	Net Energy	MJ/kg	9.8	10.0
	Metabolizable Energy	MJ/kg	13.2	13.5
	Metabolizable Energy	Mcal/kg	3.14	3.21
	Lysine SID	g/kg	9.5	9.7
	SID Lys/NE	g/MJ	0.97	0.97
	Calcium	g/kg	6.9	7
	Digestible Phosphorus	g/kg	2.8	2.8
75 - End	Ave Daily Feed Intake	Kg/day	2.60	2.49
	Net Energy	MJ/kg	9.5	9.8
	Metabolizable Energy	MJ/kg	12.8	13.2
	Metabolizable Energy	Mcal/kg	3.05	3.14
	Lysine SID	g/kg	7.8	8.0
	SID Lys/NE	g/MJ	0.82	0.82
	Calcium	g/kg	6.5	6.8
	Digestible Phosphorus	g/kg	2.6	2.7

[1] Wheat-Barley based diets.
[2] Corn-Soy based diets.

Notes

- Advised phosphorus levels are based on diets formulated without the use of Phytase. The use of Phytase implicates in the necessity of readjusting these phosphorus levels.
- NE = ME X 0.74 (The conversion factor could be different for each country).

Table 4. Nutrient boxes for Norsvin Duroc offspring: Boars

Boars

Weight Range	Nutrients	Unit	WB[1]	CS[2]
25 – 45 kg	Ave Daily Feed Intake	Kg/day	1.44	1.39
	Net Energy	MJ/kg	10.0	10.3
	Metabolizable Energy	MJ/kg	13.5	13.9
	Metabolizable Energy	Mcal/kg	3.21	3.31
	Lysine SID	g/kg	11.7	12.1
	SID Lys/NE	g/MJ	1.17	1.17
	Calcium	g/kg	8.2	8.5
	Digestible Phosphorus	g/kg	3.0	3.1
45 – 75 kg	Ave Daily Feed Intake	Kg/day	1.96	1.90
	Net Energy	MJ/kg	9.9	10.2
	Metabolizable Energy	MJ/kg	13.4	13.8
	Metabolizable Energy	Mcal/kg	3.19	3.28
	Lysine SID	g/kg	9.9	10.2
	SID Lys/NE	g/MJ	1.00	1.00
	Calcium	g/kg	7.2	7.5
	Digestible Phosphorus	g/kg	2.9	3.0
75 - End	Ave Daily Feed Intake	Kg/day	2.50	2.41
	Net Energy	MJ/kg	9.6	9.9
	Metabolizable Energy	MJ/kg	13.0	13.4
	Metabolizable Energy	Mcal/kg	3.09	3.19
	Lysine SID	g/kg	8.2	8.4
	SID Lys/NE	g/MJ	0.85	0.85
	Calcium	g/kg	6.7	6.9
	Digestible Phosphorus	g/kg	2.7	2.8

[1] Wheat-Barley based diets.
[2] Corn-Soy based diets.

Notes

- Advised phosphorus levels are based on diets formulated without the use of Phytase. The use of Phytase implicates in the necessity of readjusting these phosphorus levels.
- NE = ME X 0.74 (The conversion factor could be different for each country).

6. Specific situations

6.1 Ad libitum vs. restricted feeding

This manual provides our clients with calculated requirements for daily energy and lysine levels. However, due to variation in feed intake, daily requirements alone are not enough. Feed consumption by pigs at various body weights (or over time) is necessary to design a proper feeding program. Estimation of actual feed intake for pigs fed ad libitum can be a good indicator of appetite, management quality, herd health and housing environment. To achieve optimal growth in Norsvin Duroc offspring, essential nutrients (AA and energy) must not be limited. Ideal ratios for energy and lysine content is provided in this manual, and it is essential to keep these ratios at recommended levels whether animals are fed ad libitum or restrictedly. Topigs Norsvin recommends that Norsvin Duroc offspring are fed ad libitum.

6.2 Health conditions

The efficiency of nutrient utilization in pigs is optimized under high health environments. Improved health conditions increases the pigs nutrient demands because of increased productivity and efficiency. When pigs are immunologically challenged, nutrients are diverted away from productive functions (e.g., lean tissue growth) towards the activated immune system. Under conventional health situations (most farms in the world), the immune system of the animal has to cope with different kinds of pathogens. Under SPF conditions the animals can increase their feed intake with ±10 -15%, reduce maintenance with some 10% and increase protein deposition capacity with around 25g/d.

The following points need to be taken under consideration for SPF animals:

- SPF animals grow faster, therefore have the capacity to reach higher protein deposition rates.
- The higher feed intake capacity in SPF animals does not reflect in an increased protein deposition level, if the protein: energy ratio's in the diet is limited.

6.3 Paylean® (Ractopamine)

Ractopamine-HCl, is a β-adrenergic agonist, and is labelled for use in swine diets during the final growth stages. Dietary inclusion has shown consistent improvement in pig growth performance and has led to its widespread use in the swine industry. When fed, it promotes lean growth rather than fat deposition by directing nutrients away from the fat depots towards muscle development. Fat tissue deposition requires more energy than lean growth, thus increasing lean deposition leads to improved feed efficiency prior to market and a leaner carcass. Because of the increased protein accretion, pigs that are fed Ractopamine have an increased dietary amino acid requirement. Topigs Norsvin advice is to follow the nutritional guidelines of the specific manufacturer, when using these additives.

6.4 Pellet vs. Mash feed

The feeding behaviour and performance of pigs can be influenced by the feed type (pellet vs. mash). Feeding pelleted diets to finishers has been shown to increase nutrient digestibility and improve FCR with 5% to 8%. Improved performance has also been attributed to decreased feed wastage, reduced selective feeding, decreased ingredient segregation, less time and energy expended for prehension, destruction of pathogens, thermal modification of starch and protein, and improved palatability. The improvements in FCR are highly depended on pellet quality, percentage fines and pellet size. Another advantage to pelleted diets is the ability to grind grains to smaller micron sizes and to use a higher percentage of alternative ingredients in the diets and still maintain good feed flowability.
All the feed curves given in this manual are based on mash diets, therefore the total nutrient intake when using pelleted feed can be higher.

6.5 Hot climates

The environment can serve as a significant factor affecting both the voluntary feed intake level and the overall nutrient requirements of pigs. Temperature, probably more than any other environmental factor, can explain a majority of the variations associated with differences in feed intake and performance among groups of pigs. Given the fact that animals tend to eat less when temperature rises, feed intake capacity can be a limiting factor for optimal performance. Swine diet formulations should be adjusted to account for the variations in feed intake associated with temperature changes.

Pigs living in hot climates will automatically reduce their feed intake to lessen their heat production that occurs due to the thermal effect of feed (TEF). The reduced feed intake can result in a decreased growth performance, and hence affect the profitability of the swine producers. This can be avoided with the correct diet composition and/or changes in feeding management.
What might be beneficial is:

(1) Low crude protein diets. Practically, crude protein is partially replaced by starch and/or fat and industrial amino acids in order to meet the protein requirement for optimal performance.
(2) Offer the feed during cooler phases of the day/night.
(3) Feed more times per day. Feed will be less per meal and have a lower influence on the energy needed to digest / internal heat etc.
(4) Ensure the availability of fresh clean water. Water should be available *ad libitum*. Ensure a minimum flow rate of 1.5 litres per minute.

6.7 Liquid feeding

Working with liquid feeding systems requires good control of diet composition and hygiene. For each type of diet there is an ideal dilution, which depends on the ingredients used and on how each one was included. There can be decomposition into sub products which do not have proper time to be incorporated to the liquid diet, losses of vitamins and essential nutrients can also occur. When considering the type of grain to be used in the feed, it is important to consider the chemical composition and the effects that the raw materials can have on the digestibility. Therefore, we advise regular laboratory analyses of the feed to guarantee that the pigs are not fed diets that can limit their performance and/ or affect the carcass quality negatively.

6.8 Split sex feeding

In general, gilts will consume 7 to 8% less feed and have a better FCR during the finishing period than castrates. To ensure that their daily requirements are met, gilt diets must therefore contain higher levels of protein. Boars will even be more efficient than gilts. The differences in feed intake, together with the differences in performance and carcass parameters, provide the basis for split-sex feeding.

Appendix

1. Amino acid/Lysine ratio used to estimate amino acid requirements

Lysine is the first limiting amino acid in most swine diets. It is common practice to first define the adequate lysine level in the diet and then derive the required level of other essential amino acids from lysine on the basis of an ideal protein ratio, thus giving a balanced protein diet. A balanced protein diet contains sufficient levels of each essential amino acid to meet the biological needs of the animal while minimizing the amounts of excess amino acids. The InraPorc® (2011) has defined the ideal balance of amino acids for each phase of production based on the concept of Ideal Protein. This serves as basis for the Topigs Norsvin recommendations. Feed ingredients have different amino acid digestibility coefficients. Therefore, when formulating diets that are more complex, it is recommended that standardized ileal digestible (SID) values are used in the formulation process.

Table 1. Amino acid ratios for finishers in a 3 phase feed program

Amino Acids[1]	**Starter**	**Grower**	**Finisher**
Lysine	100	100	100
Methionine	28	30	31
Met + Cys	60	62	64
Tryptophan	20	19	19
Threonine	65	67	70
Arginine	42	42	42
Valine	68	68	68
Isoleucine	55	53	53
Leucine	100	100	100
Histidine	32	32	32
Phenylalanine	50	50	50

[1] All Amino Acids are expressed as standardized ileal digestible (SID).

2. Vitamin and mineral recommendations for Norsvin Duroc offspring

Table 2. Vitamins recommendations

VITAMINS	Units	All Sexes					
		25 – 45 kg		45 – 75 kg		75 - End	
FAT SOLUBLE VITAMINS		*Min*	*Max*	*Min*	*Max*	*Min*	*Max*
VIT. A	i.u	7000	10000	7000	10000	5000	7500
VIT. D_3	i.u	1500	2000	1500	2000	1000	1500
VIT. E	i.u	40	100	40	100	30	75
VIT. K_3	mg	2	3	2	3	1,5	2
WATER SOLUBLE VITAMINS							
VIT. B_1 (Thiamine)	mg	2	3	2	3	1	2
VIT. B_2 (Riboflavin)	mg	7	10	7	10	5	8
VIT. B3 (Nicotinic acid)	mg	20	40	20	40	15	30
VIT. B5 (Pantothenic acid)	mg	10	45	10	45	7	35
VIT. B_6 (Pyridoxine)	mg	2	4	2	4	1,5	3
VIT. B_{12} (Cobalamin)	mcg	30	50	30	50	20	40
VIT. B9 (Folic acid)	mg	0,4	1,5	0,4	1,5	0,25	1
VIT. B7 (Biotin)	mcg	40					
Choline	mg	150	300	150	300	100	200

Notes

- Vitamin requirements are based on the latest recommendations and were derived from various sources.
- Comply with the local legislation given per country.

Table 3. Minerals recommendations

MINERALS	Units	All sexes					
		25 – 45 kg		45 – 75 kg		75 - End	
		Min	*Max*	*Min*	*Max*	*Min*	*Max*
Na	%	0,2	0,25	0,15	0,22	0,12	0,2
K	%		1,1		1,3		1,3
Mg	%		0,25		0,3		0,3
Fe	ppm	120		120		80	
I	ppm	1,5	4	1,5	4	1	3
Se	ppm	0,3	0,5	0,3	0,5	0,3	0,5
Cu	ppm	150		20		20	
Zn	ppm	120		120		100	
Mn	ppm	75		75		50	
Cl	%	0,15		0,15		0,15	

Notes

- Mineral requirements are based on the latest recommendations and were derived from various sources.
- Comply with the local legislation given per country.

3. Water quality standards

Water is essential for normal body functions such as growth, reproduction, body temperature regulation, absorption and transport of nutrients, waste excretion, joint lubrication, and cushioning of nerves. Water intake mainly depends on body weight, feed intake and temperature. Heavier pigs thus need more water to maintain their body than animals weighing less. Pigs must consume sufficient water on a daily basis to balance the amount of water lost. Water flow rates from nipple drinkers should be higher than 1500 ml/minute.

Table 4. Water Quality Guidelines for Pigs

	Water Quality Standards	
Item	**Good**	**Toxic**
Total Dissolved Solids (TDS)		>3000
Sulphate (mg/L)	< 100	> 250
Hardness (° D)	< 15	> 25
Nitrite (mg/L)	< 0.1	> 1
Nitrate (mg/L)	< 100	> 200
Iron (mg/L)	< 0.5	> 10
pH	5 – 8.5	> 9 & < 4
Ammonia (mg/L)	< 1	> 2
Sodium (mg/L)	< 400	> 800
Chloride (mg/L)	< 250	> 2000
Manganese (mg/L)	< 1	> 2

Source: Guidelines for water quality in pigs (GD Nederland)

4. Standardized ileal digestible (SID) vs. apparent ileal digestible (AID) lysine

The terminology used to describe the bioavailability and ileal digestibility of amino acids in pig feed ingredients are explained in this appendix. Ileal digestibility values may be expressed as apparent ileal digestibility (AID), standardized ileal digestibility (SID), or true ileal digestibility (TID). These terms are used to specify how ileal endogenous AA losses are reflected in digestibility values. Ileal endogenous AA losses may be separated into basal losses, which are not influenced by feed ingredient composition, and specific losses, which are induced by feed ingredient characteristics such as levels and types of fibre and anti-nutritional factors. Values for AID are established when total ileal outflow of AA (i.e., the sum of endogenous losses and no digested dietary AA) is related to dietary AA intake. A concern with the use of AID values is that these are not additive in mixtures of feed ingredients. This concern may be overcome by correcting AID values for defined basal endogenous losses of AA, which yields SID values. Furthermore, if the AID values are corrected for basal and specific endogenous losses, then values for TID are calculated. However, reliable procedures to routinely measure specific endogenous losses are not yet available. It is suggested that SID values should be used for feed formulation, at least until more information on TID values becomes available.

Table 5. Example of the differences between SID and AID Lys for Norsvin Duroc Castrates

SID Lysine and AID Lysine			
		25 - 50 kg	
	Basal (g/kg DM)	**SID Lysine**	**AID Lysine**
Lysine	0.040	1.000	0.964
Methionine	0.011	0.280	0.270
Methionine + Cysteine	0.021	0.600	0.581
Threonine	0.061	0.650	0.596
Tryptophan	0.014	0.180	0.167

5. Phosphorus

Phosphorus is one of the most significant minerals in swine nutrition. It is essential for bone development, plays a key role in metabolic processes such as the formation of cellular membranes and is vital for enzymatic systems involved in protein and carbohydrate metabolism. The ratio between Calcium and Phosphorus is of importance because these minerals are antagonists of each other which mean that an oversupply of calcium can work negatively for the digestibility of Phosphorus.

There are two expressions used for the phosphorus calculation by nutritionists: Available Phosphorus and digestible Phosphorus. The definition is as follows:

Available Phosphorus = Total Phosphorus – Inositol Phosphorus

Digestible Phosphorus = P intake – Faecal P / P Intake

In raw materials, a large amount of Phosphorus is in the form of Phytic acid (myo-inositol hexaphosphate). The Phosphorus in Phytic acid is largely unavailable to the pig. Thus, a phytase enzyme is added to diets to enhance the pig's ability to use Phosphorus from Phytic acid. Because manufacturers have their own individual analytical techniques, it is often confusing to compare phytase sources by a single analytical method. To avoid this confusion, Topigs Norsvin indicate the Phosphorus requirements without any influences of the Phytase enzymes.

The available Phosphorus levels for maintenance and gain were estimated using the following equations based on Jongbloed *et al*. (1993) and Rostagno *et al.* (2011) :

Castrates
25 – 50 kg - Available Phosphorus (g/day) = 0,046 x $BW^{0,75}$ + 5,81 x ADG (kg)
51 – 130 kg - Available Phosphorus (g/day) = 0,046 x $BW^{0,75}$ + 5,33 x ADG (kg)

Gilts and boars
25 – 130 kg - Available Phosphorus (g/day) = 0,046 x $BW^{0,75}$ + 5,96 x ADG (kg)