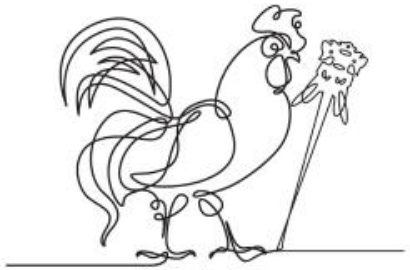


23rd European Symposium on Poultry Nutrition

ESPN 2023

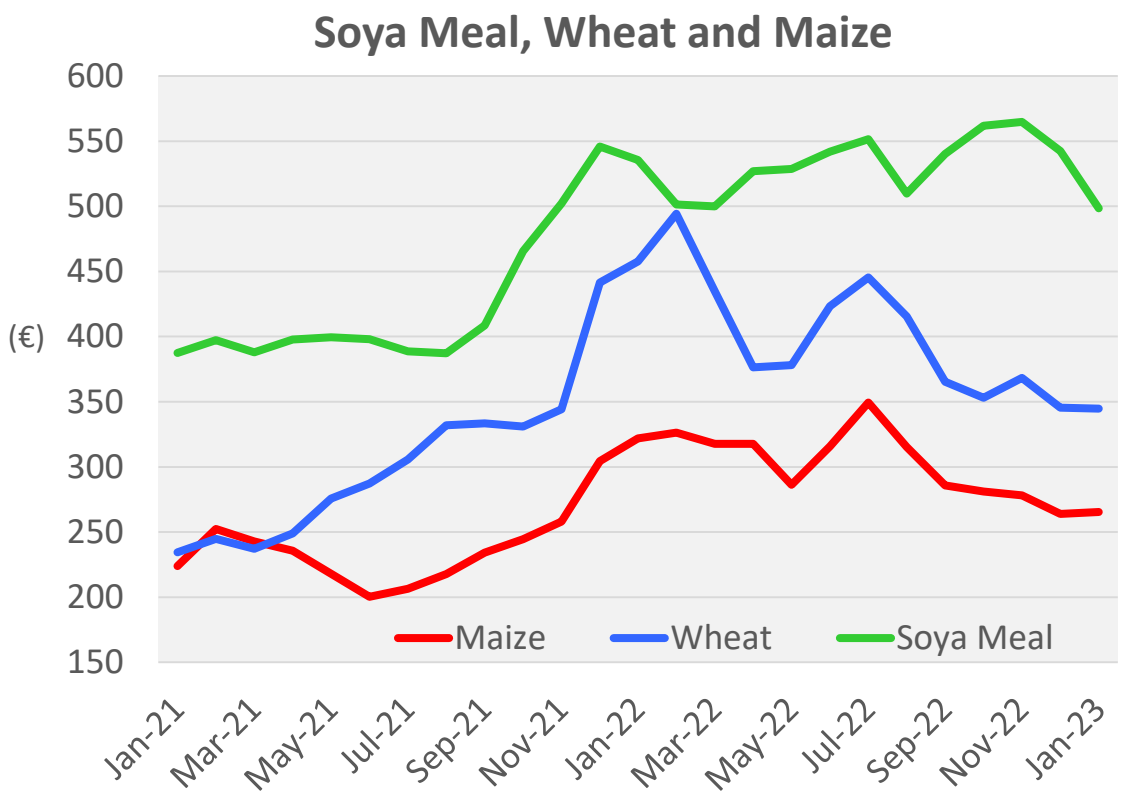
RIMINI/ITALY JUNE 21 - 24

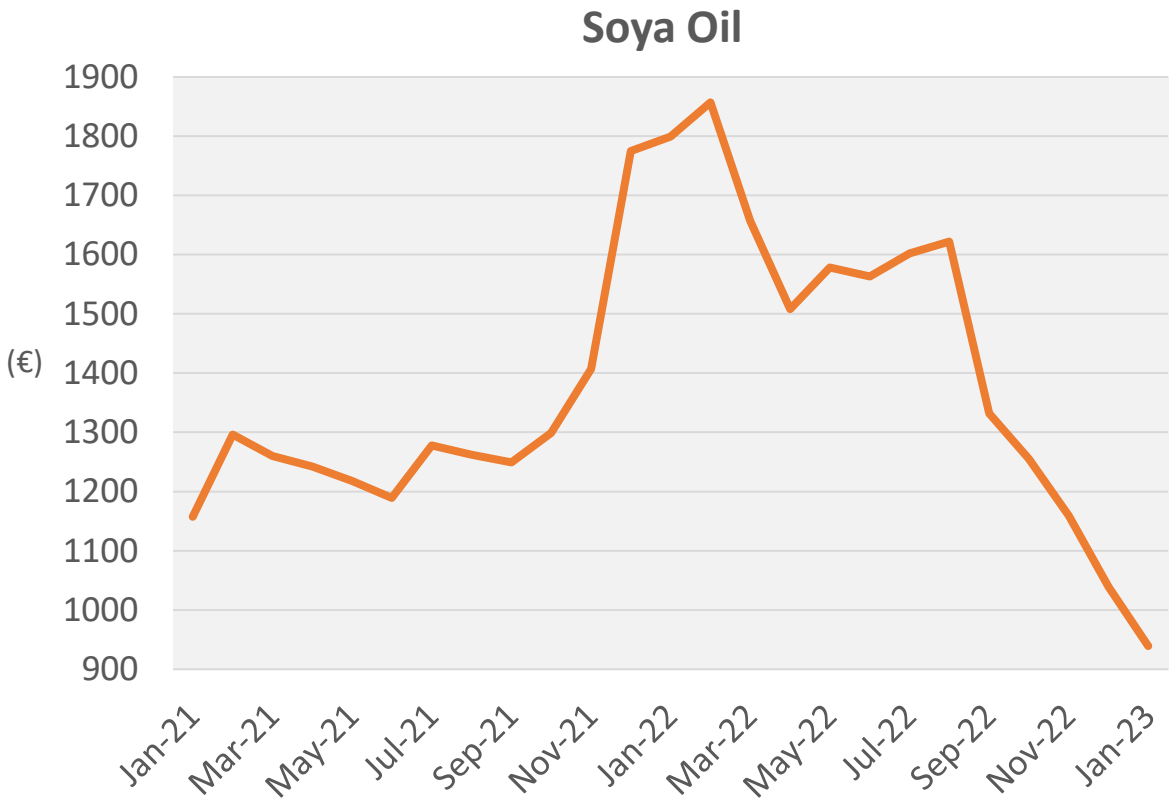
Title: **Economical efficiency in turkey nutrition**

M Kenny[1], J Ralph[1] and H Glawatz[2]
[1]Aviagen Turkeys Ltd, Chowley Five, Chowley Oak Lane, Tattenhall, Chester CH3 9GA United Kingdom
[2]Moorgut Kartzfehn von Kameke GmbH & Co KG, Germany

Raw material prices (€/MT) : Jan 2021 to Jan 2023

- Volatility of the raw material market and lack of consistent supply of materials.





- The current raw material market appears to be more settled however; the future is far from predictable.
- Considering economic efficiency has never been more important.

Source: Indexmundi.com

Nutrition Economics

- Feed is the single largest cost to the organisation.

2020: 64% cost
2023: 70% cost
+6% increase

- Nutrient density should be adequate to support bird performance but low enough to minimise feed cost.

- Understanding how the modern bird responds to these nutrients is necessary in order to assess economics.

Heavy Strain Feeding Programme						
Feed Code	Name	Age Fed Males	Age Fed Females	Form	Energy (AME/kg)	Digestible Lysine (%)
1001	Starter 1 ACS	0 - 3	0 - 3	Crumble	11.9	1.67
1002			6	Short Cut Pellet	12.2	1.48
1003			8	Pellet	12.6	1.30
1004			10	Pellet	12.9	1.14
1005			12	Pellet	13.2	1.01
1006				Pellet	13.5	0.89
1007				Pellet	13.8	0.77

Energy and amino acids are the main contributors to diet cost

Medium Strain Feeding Programme						
Feed Code	Name	Age Fed Males	Age Fed Females	Form	Energy (AME/kg)	Digestible Lysine (%)
1001	Starter 1 ACS	0 - 3	0 - 3	Crumble	11.5	1.70
1002	Starter 2 ACS	4 - 6	4 - 6	Short Cut Pellet	11.9	1.51
1003	Grower 1 ACS	7 - 9	7 - 8	Pellet	12.3	1.34
1004	Grower 2	10 - 12	9 - 10	Pellet	12.8	1.19
1005	Finisher 1	13 - 15	11 - 12	Pellet	13.2	1.06
1006	Finisher 2	17 - 18	13 - 14	Pellet	13.6	0.93
1007	Finisher 3	19 - 21	15 - 18	Pellet	13.8	0.81

Response of male BUT6 turkeys to varying amino acid densities in different phases

Period	Ages Fed (weeks)	1	2	3*	4	5	6
P1	1 - 2	100	120	120	120	120	90
P2	3 - 5	100	120	120	120	120	90
P3	6 - 9	100	120	120	100	120	90
P4	10 - 13	100	120	100	100	120	100
P5	14 - 17	100	90	90	90	100	100
P6	18 - 22	100	90	90	90	100	100

	Unit	1	2	3	4	5	6
Weight	kg	20.46	20.07	20.36	20.78	20.39	20.47
FCR		2.585^{ab}	2.575^{b}	2.681^{ab}	2.602^{ab}	2.626^{a}	2.596^{ab}
Carcass	% of LW	71.51^{ab}	71.59^{ab}	71.92^{a}	71.08^{b}	72.10^{a}	72.15^{a}
Breast	% of CW	33.26^{ab}	32.36^{b}	32.59^{b}	33.60^{ab}	**34.03^{a}**	33.03^{ab}

*only 3 replicates, **% amino acids, ***breast without skin and bones, ****different superscripts indicate significant differences, $p<0.05$

Lemme *et al.* 2005

Final bodyweights were not influenced by dietary amino acid levels as much as breast meat yield which was higher in those birds fed higher amino acid levels.

Response of male BUT6 turkeys to varying amino acid feeding programmes

		Treatment					
Period	Ages Fed (weeks)	1	2	3*	4	5	6
P1	1 - 2	100	120	120	120	120	90
P2	3 - 5	100	120	120	120	120	90
P3	6 - 9	100	120	120	100	120	90
P4	10 - 13	100	120	100	100	120	100
P5	14 - 17	100	90	90	90	100	100
P6	18 - 22	100	90	90	90	100	100
Parameter**							
IOFC/bird		8.50	8.06	8.25	**9.15**	7.06	8.79
IOFC/breast meat per bird		11.35	10.24	10.73	**12.14**	10.67	11.69
IOFC/pen (body weight)		559	516	525	594	461	**602**
IOFC/pen (breast meat)		746	655	683	789	696	**801**

*only 3 replicates, **1% feed price increase per point of dietary amino acids

Lemme *et al.* 2005

Optimal economic performance (income over feed cost/bird and breast) was achieved in those birds fed higher amino density diets in the early phases, control levels in the intermediate phase and lower amino acid levels in the later phases.

Study of the response of male heavy turkeys to lysine and ideal protein intake from 0 to 48 days and energy and lysine intake from 62 to 124 day

Amprou (2018) assessed the effect of two digestible lysine levels and energy levels on heavy strain turkeys fed between 62 to 124 days of age.

- Reducing the energy content of the diets had no impact on growth but resulted in poorer FCR.
- Increased digestible lysine improved growth but had no effect on FCR.
- A financial assessment based on mass production cost showed the lower energy and higher digestible lysine regime resulted in the lowest cost relative to all other treatments.

Summary

The liveweight and FCR response to amino acid density is variable.

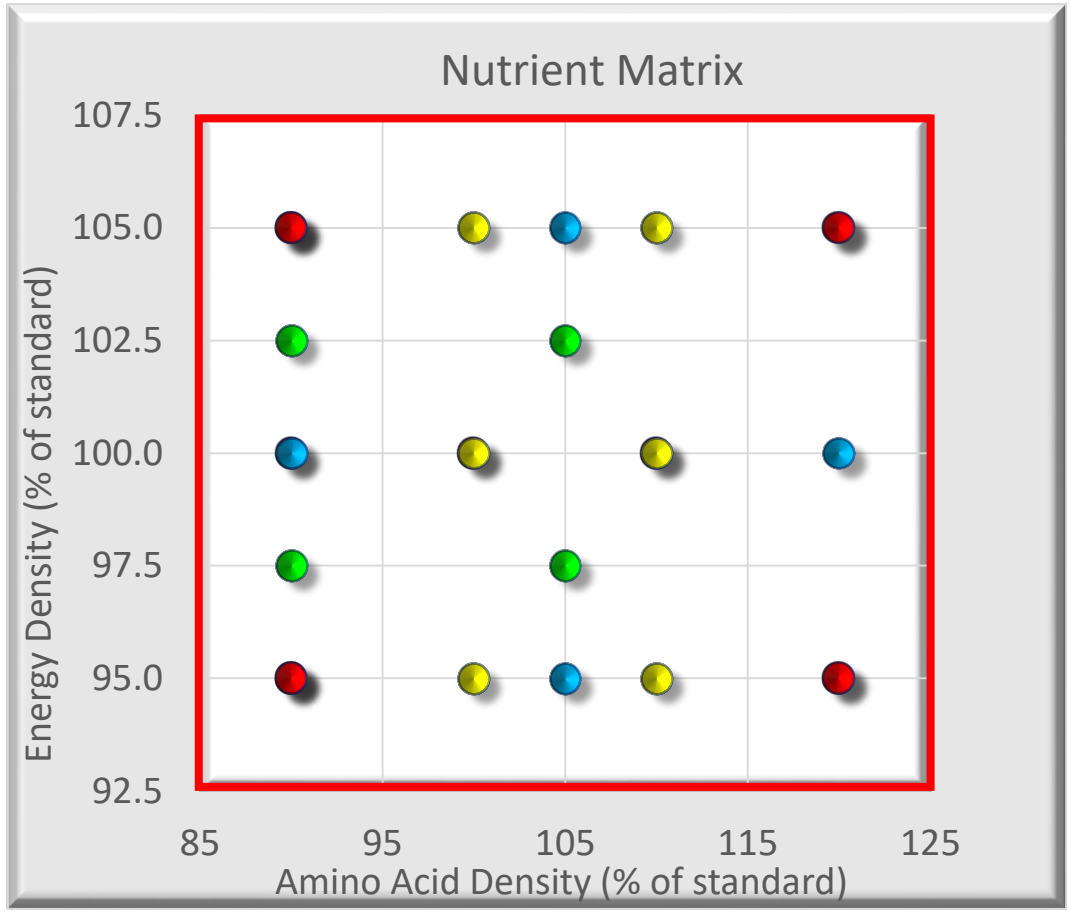
Minimal assessments conducted on energy responses.

Attempting to establish a trend in economic response to nutrient density across trials is challenging.

Summary of Trials

Trial Number	Sex	Age		Treatments (% of standard)	
		Weeks	Days	Amino Acids	Energy
1	Male	21	147	90, 120	95, 105
2	Male	20	140	90, 100, 110, 120	100
3	Male	17	119	90, 105, 120	95, 105
4	Male	20.6	144	90, 105	97.5, 102.5
5	Female	16	112	90, 100, 110	95, 100, 105

Nutrient Levels In Feed Treatments

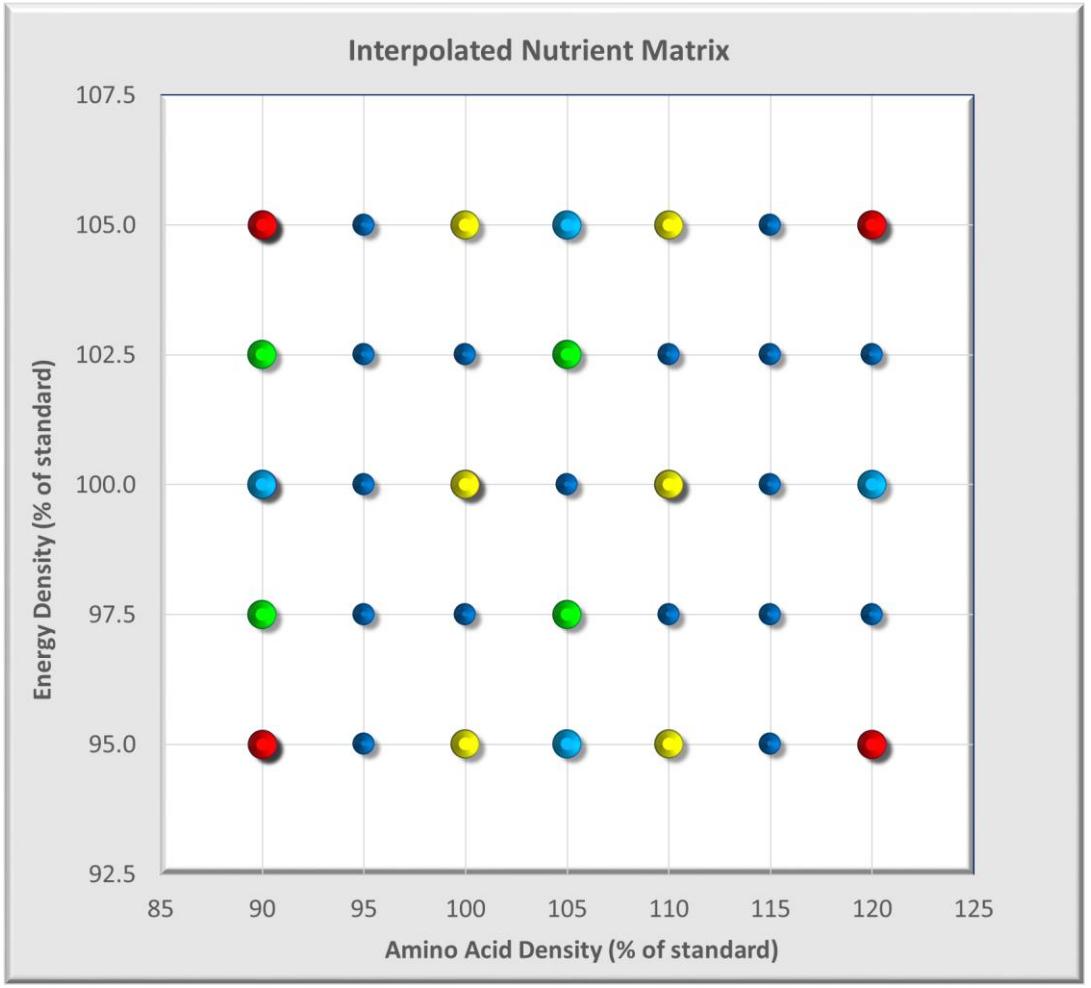


	Standard						
	P1	P2	P3	P4	P5	P6	P7
Age fed (wks)	0 to 3	4 to 6	7 to 9	10 to 12	13 to 15	16 to 18	19 to 21
d.lysine (%)	1.57	1.45	1.31	1.15	1.04	0.93	0.88
ME (MJ/kg)	11.6	11.8	12.2	12.5	12.8	13.2	13.4

	ME (MJ/kg)						
105.0%	11.60	12.34	12.81	13.13	13.44	13.86	14.08
102.5%	11.60	12.04	12.51	12.81	13.12	13.53	13.75
100.0%	11.60	11.75	12.20	12.50	12.80	13.20	13.41
97.5%	11.60	11.46	11.90	12.19	12.48	12.87	13.07
95.0%	11.60	11.16	11.59	11.88	12.16	12.54	12.74

Amino Acids (% of standard)	Digestible Lysine (%)						
120%	1.57	1.74	1.57	1.38	1.25	1.12	1.06
115%	1.57	1.67	1.51	1.32	1.20	1.07	1.01
110%	1.57	1.60	1.45	1.25	1.20	1.10	1.00
105%	1.57	1.52	1.38	1.21	1.09	0.98	0.92
100%	1.57	1.45	1.31	1.15	1.04	0.93	0.88
95%	1.57	1.38	1.24	1.09	0.99	0.88	0.84
90%	1.57	1.31	1.18	1.04	0.94	0.84	0.79

Feed Treatments

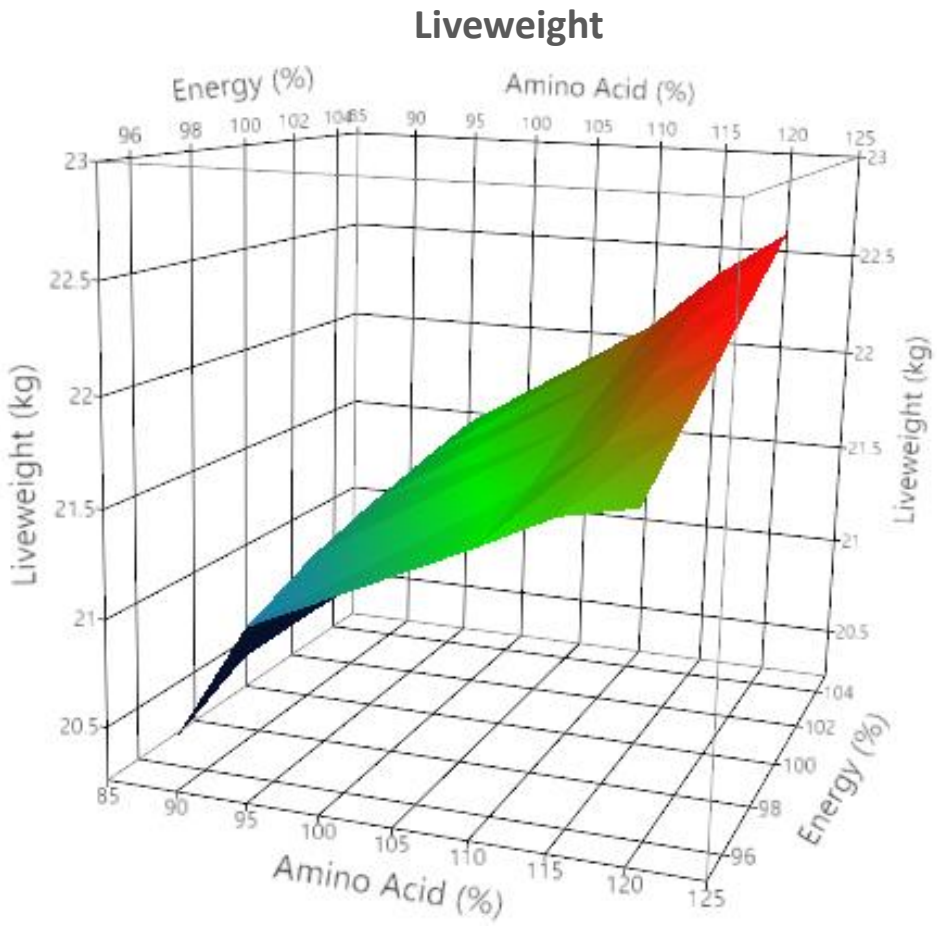


	Standard						
	P1	P2	P3	P4	P5	P6	P7
Age fed (wks)	0 to 3	4 to 6	7 to 9	10 to 12	13 to 15	16 to 18	19 to 21
d.lysine (%)	1.57	1.45	1.31	1.15	1.04	0.93	0.88
ME (MJ/kg)	11.6	11.8	12.2	12.5	12.8	13.2	13.4

	ME (MJ/kg)						
105.0%	11.60	12.34	12.81	13.13	13.44	13.86	14.08
102.5%	11.60	12.04	12.51	12.81	13.12	13.53	13.75
100.0%	11.60	11.75	12.20	12.50	12.80	13.20	13.41
97.5%	11.60	11.46	11.90	12.19	12.48	12.87	13.07
95.0%	11.60	11.16	11.59	11.88	12.16	12.54	12.74

Amino Acids (% of standard)	Digestible Lysine (%)						
120%	1.57	1.74	1.57	1.38	1.25	1.12	1.06
115%	1.57	1.67	1.51	1.32	1.20	1.07	1.01
110%	1.57	1.60	1.45	1.25	1.20	1.10	1.00
105%	1.57	1.52	1.38	1.21	1.09	0.98	0.92
100%	1.57	1.45	1.31	1.15	1.04	0.93	0.88
95%	1.57	1.38	1.24	1.09	0.99	0.88	0.84
90%	1.57	1.31	1.18	1.04	0.94	0.84	0.79

Nutrient matrix: BUT6 20.5-week liveweight response to altering amino acid and energy density



Amino Acid Density: % of Standard							
90	95	100	105	110	115	120	
20.65	21.04	21.44	21.84	22.07	22.37	22.59	105.0
20.67	21.03	21.38	21.69	21.92	22.20	22.39	102.5
20.67	21.00	21.33	21.55	21.77	22.03	22.18	100.0
20.67	20.95	21.21	21.45	21.63	21.86	21.97	97.5
20.50	20.79	21.07	21.30	21.52	21.69	21.77	95.0

Energy Density: % of Standard

Quantify The Impact of Nutrient Density

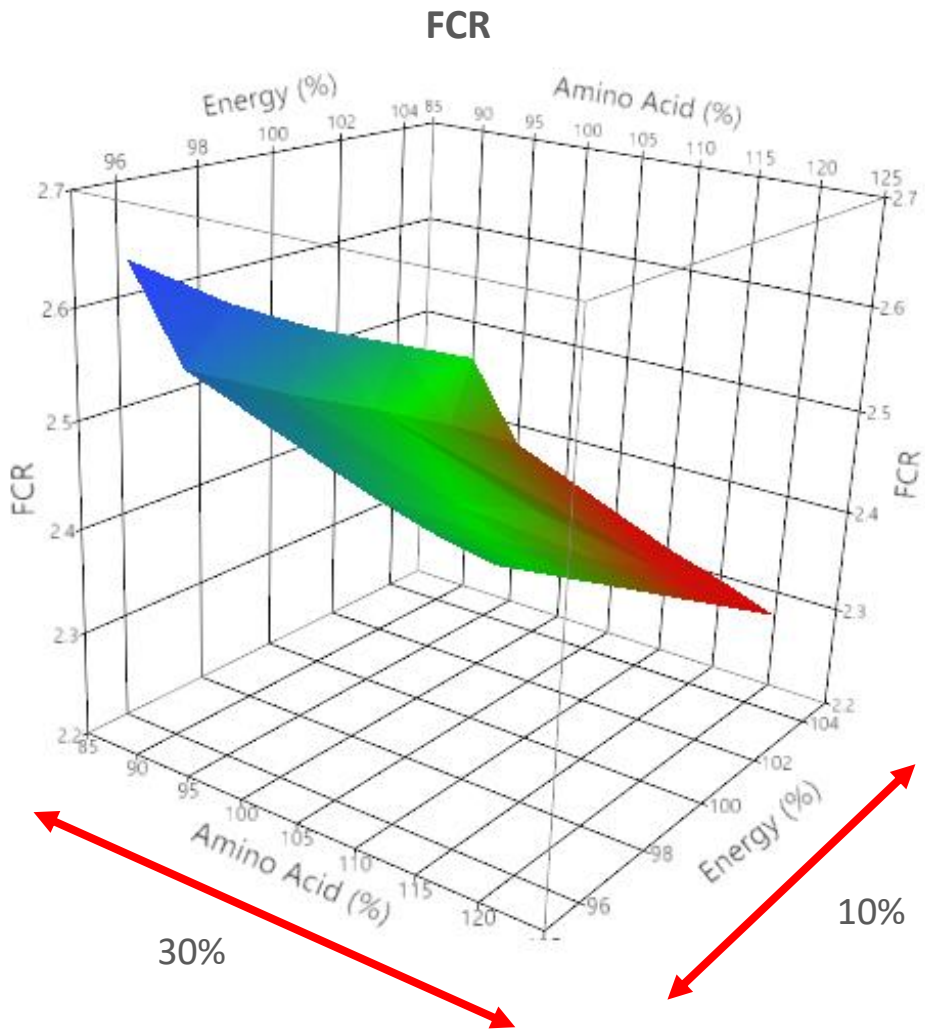
+/-260g: For every 5% change in amino acid density
+/-240g: For every 5% change in energy density

Guideline when setting the nutrient specification of diets

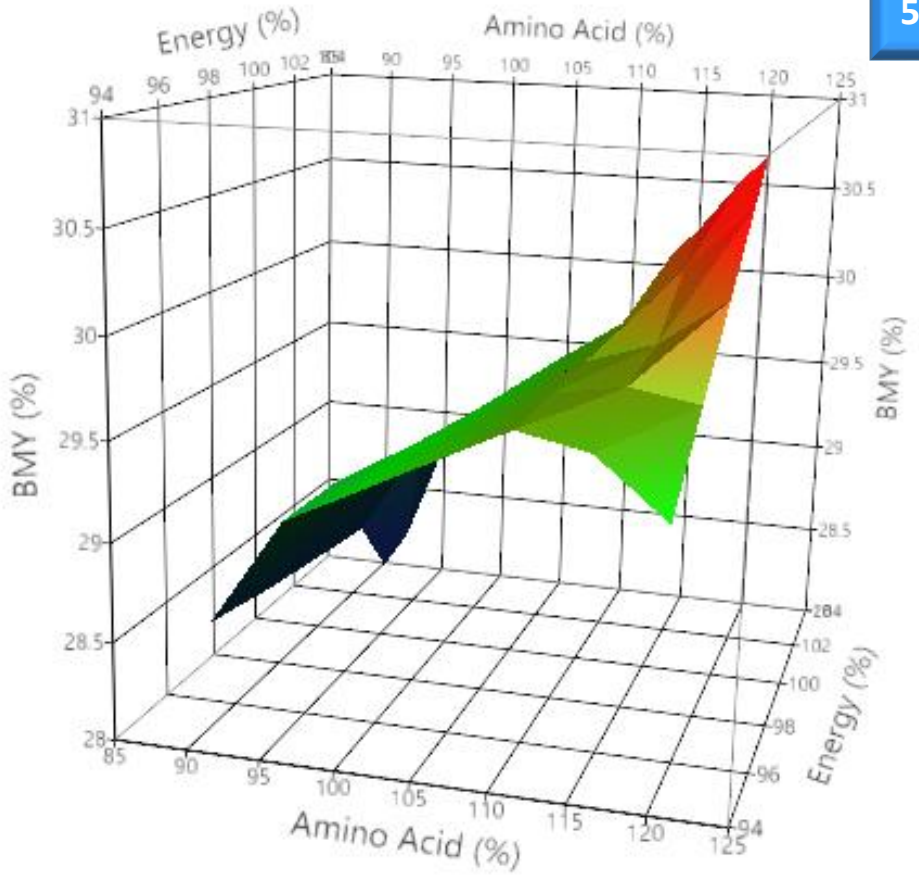
BUT 6 20.5-week FCR response to altering amino acid and energy density

Amino Acid Density: % of Standard								
90	95	100	105	110	115	120		
2.46	2.42	2.38	2.34	2.31	2.30	2.27	105.0	Energy Density: % of Standard
2.50	2.47	2.43	2.40	2.36	2.35	2.33	102.5	
2.54	2.51	2.48	2.45	2.43	2.40	2.38	100.0	
2.59	2.55	2.52	2.49	2.47	2.45	2.43	97.5	
2.65	2.61	2.57	2.53	2.51	2.50	2.49	95.0	

2.8 FCR: For every 5% change in amino acid density
10 FCR: For every 5% change in energy density



BUT 6 20.5-week breast meat yield (% liveweight) response to altering amino acid and energy density



5.73kg

6.96kg
+1.23kg

Amino Acid Density: % of standard								
90	95	100	105	110	115	120		
27.75	28.23	28.71	29.19	29.68	30.33	30.81	105.0	Energy: % of standard
28.35	28.64	28.93	29.19	29.67	30.06	30.43	102.5	
28.41	28.70	29.00	29.31	29.67	29.79	30.05	100.0	
28.47	28.78	29.10	29.39	29.66	29.73	29.67	97.5	
28.54	28.82	29.10	29.38	29.66	29.58	29.28	95.0	

0.29% BMY for every 5% change in amino acid density
0.03% BMY* for every 5% change in energy density

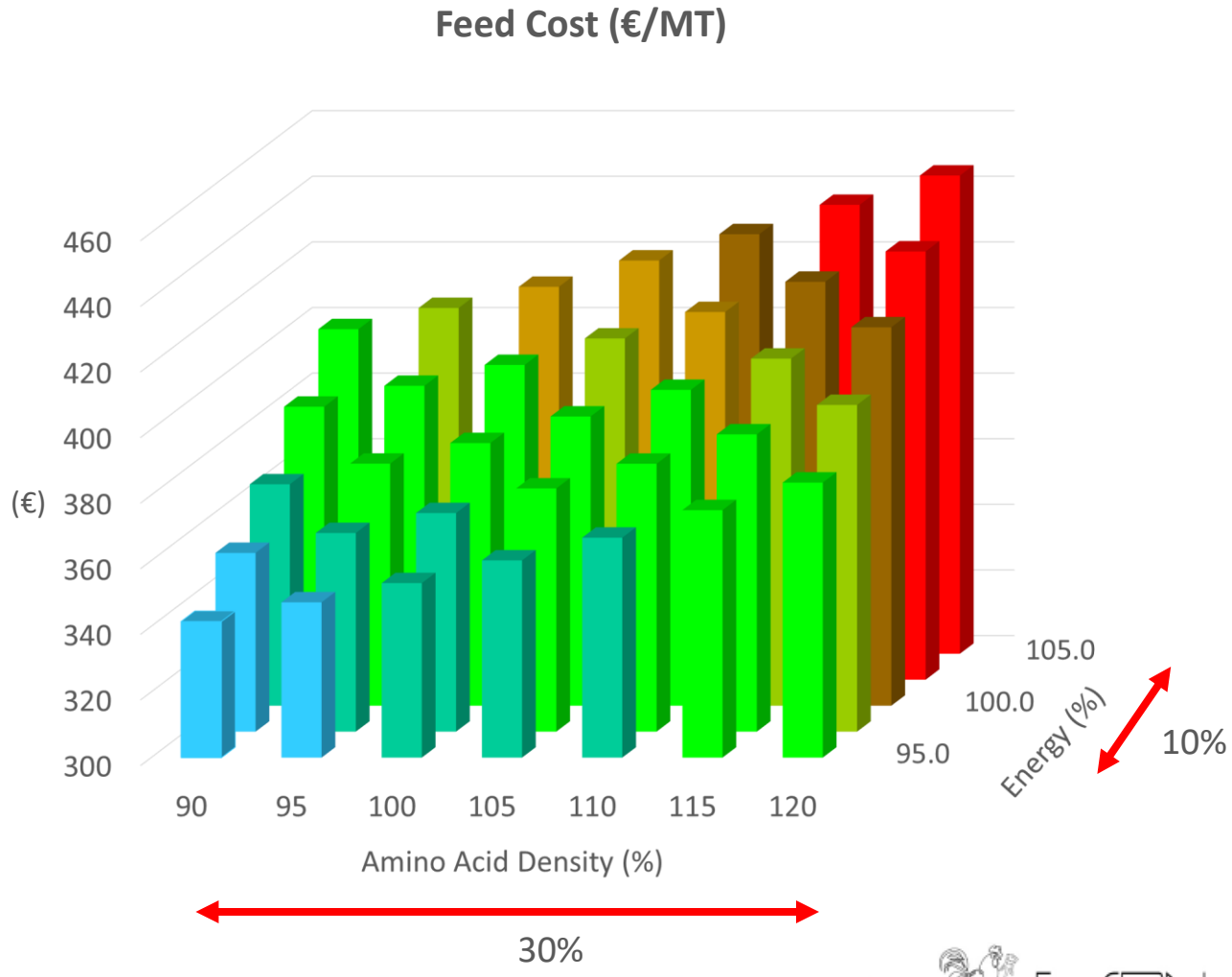
*0.27% BMY for every 5% change in energy density >100% amino acid density

Choice of nutrient density has a significant impact on processing yield!

Feed cost (€/MT) at altering amino acid and energy densities

Feed Cost (€/MT)

Amino Acid Density (%)								
90	95	100	105	110	115	120		
399	405	412	420	428	437	446	105.0	Energy (%)
383	390	396	404	412	421	431	102.5	
367	374	380	388	396	406	415	100.0	
354	361	367	374	382	391	400	97.5	
341	347	353	360	367	375	384	95.0	

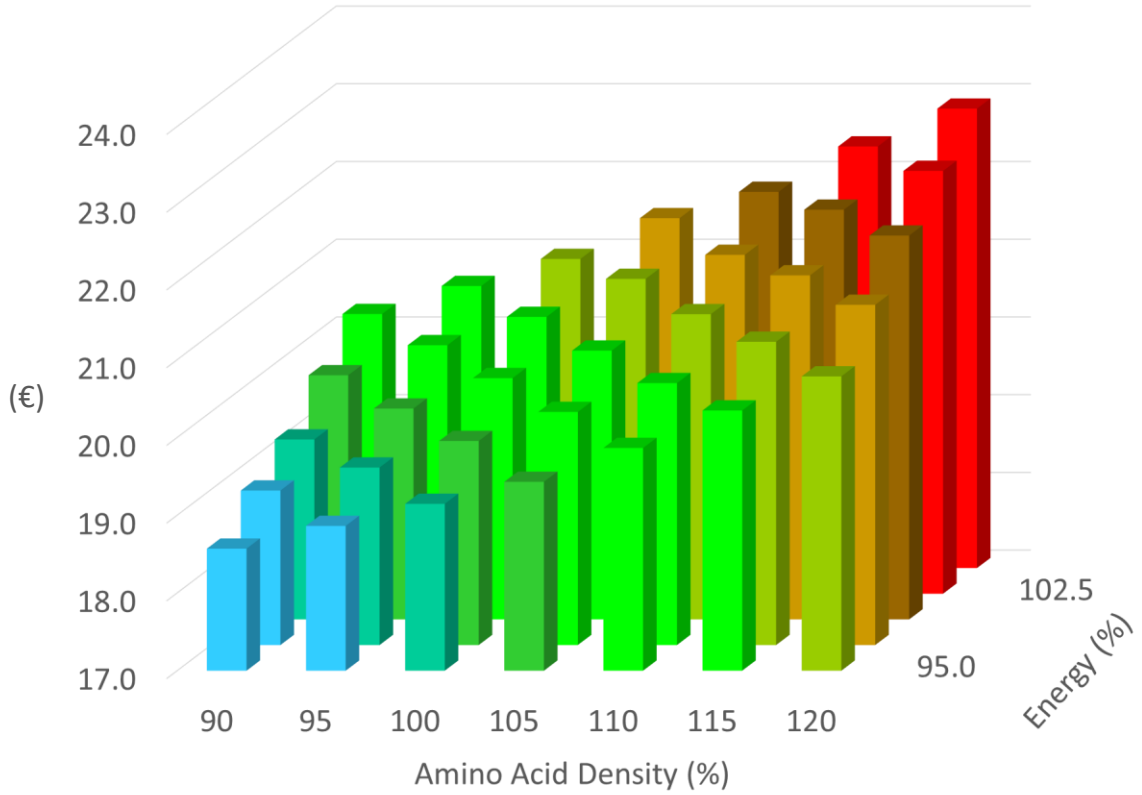


Feed cost (€/bird) at altering amino acid and energy densities

Feed Cost (€/bird)

Amino Acid Density (%)								
90	95	100	105	110	115	120		
20.3	20.6	21.0	21.5	21.8	22.4	22.9	105.0	Energy (%)
19.8	20.2	20.6	21.1	21.4	21.9	22.4	102.5	
19.3	19.7	20.1	20.5	20.9	21.4	21.9	100.0	
19.0	19.3	19.6	20.0	20.4	20.9	21.4	97.5	
18.6	18.9	19.1	19.4	19.9	20.3	20.8	95.0	

Feed Cost (€/bird)



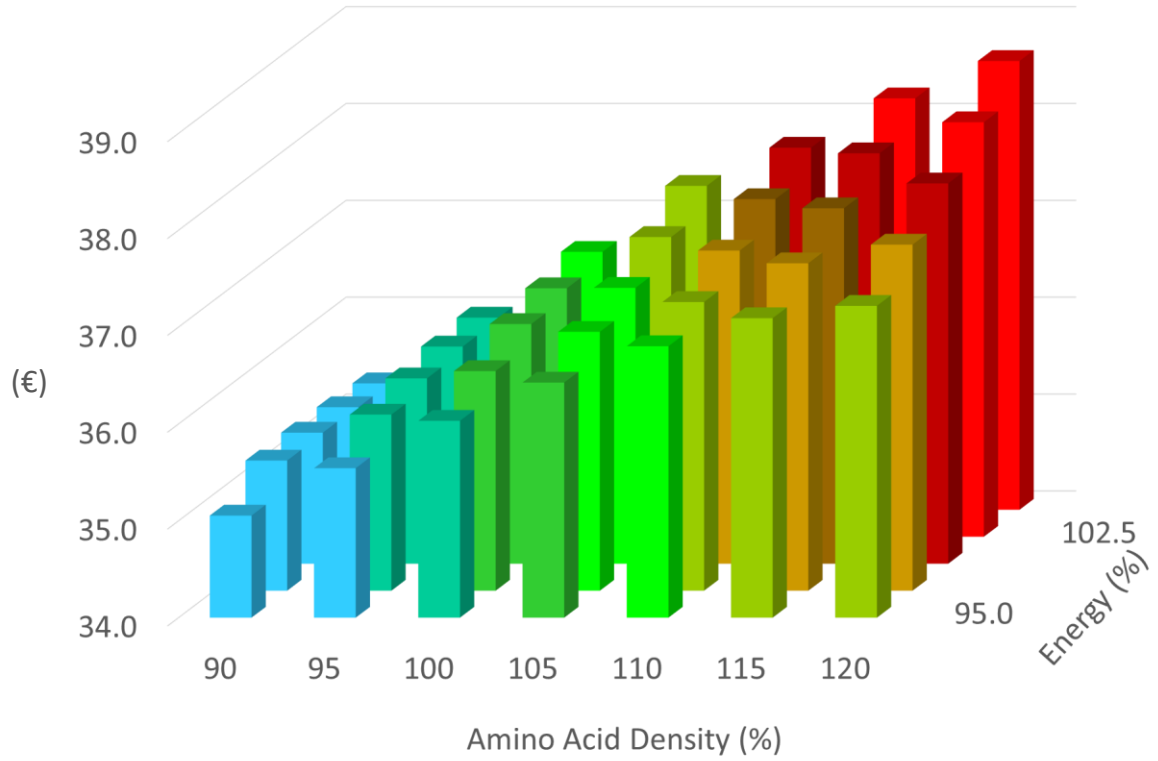
Farm revenue (€/bird) at altering amino acid and energy densities

Revenue (€/bird)

Amino Acid Density (%)							
90	95	100	105	110	115	120	
35.3	36.0	36.7	37.3	37.7	38.2	38.6	105.0
35.3	36.0	36.6	37.1	37.5	38.0	38.3	102.5
35.4	35.9	36.5	36.8	37.2	37.7	37.9	100.0
35.3	35.8	36.3	36.7	37.0	37.4	37.6	97.5
35.1	35.5	36.0	36.4	36.8	37.1	37.2	95.0

Energy (%)

*Revenue (€/bird)



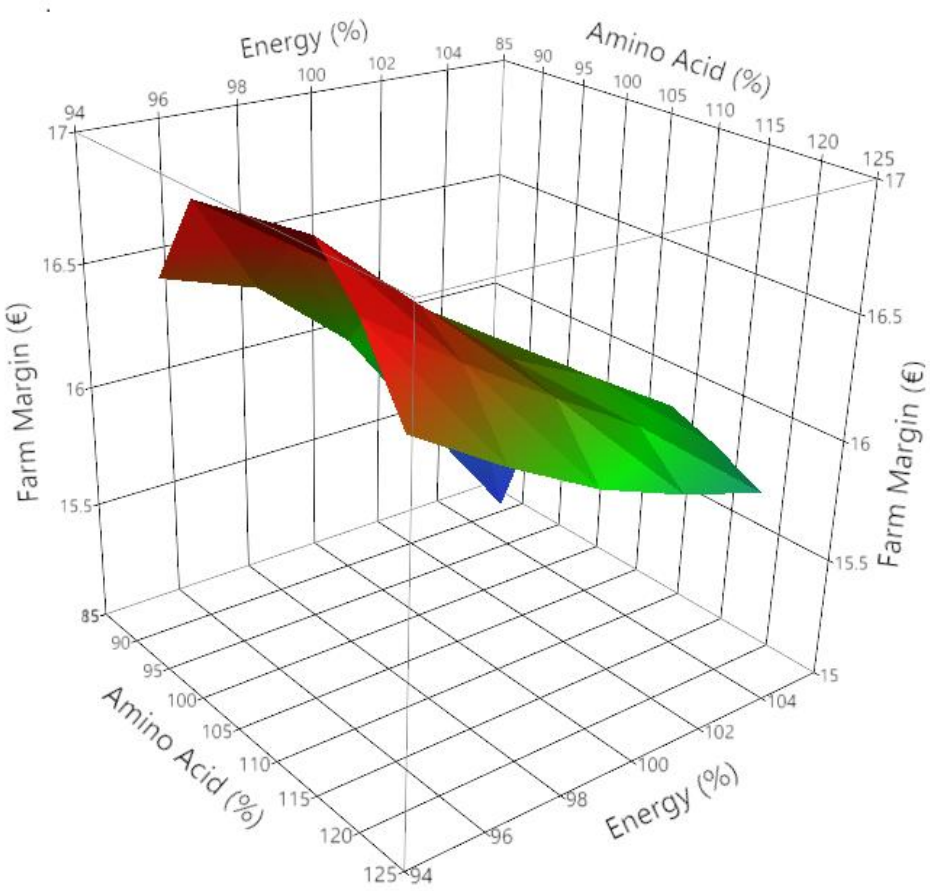
*revenue based on Euro 1.71/kg liveweight

Farm margin (€/bird) after feed cost at differing amino acid and energy densities

Margin (€/bird)

Amino Acid Density (%)								
90	95	100	105	110	115	120		
15.0	15.4	15.7	15.8	15.9	15.8	15.7	105.0	Energy (%)
15.5	15.8	16.0	16.0	16.1	16.0	15.8	102.5	
16.0	16.2	16.4	16.4	16.3	16.2	16.0	100.0	
16.4	16.5	16.6	16.7	16.6	16.5	16.2	97.5	
16.5	16.7	16.9	17.0	16.9	16.7	16.4	95.0	

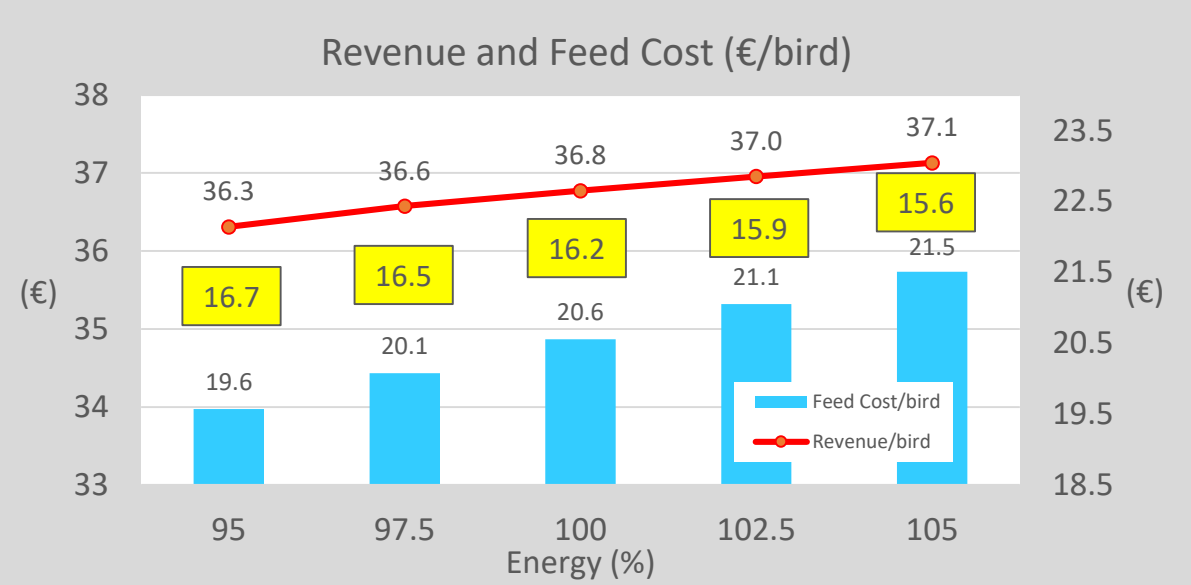
Margin (€/bird)



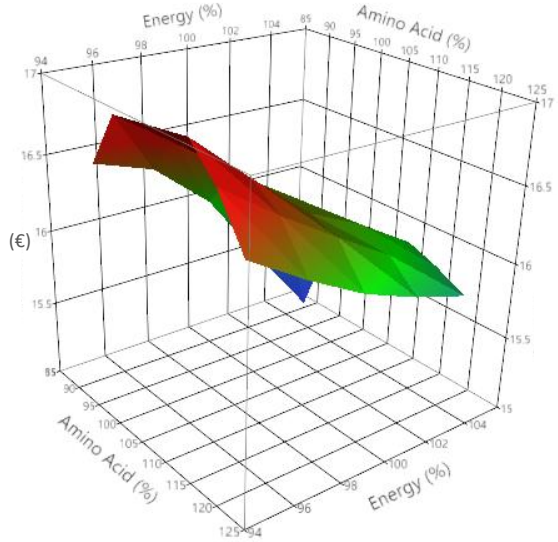
[1]*revenue based on Euro 1.71/kg liveweight*

Farm Margin

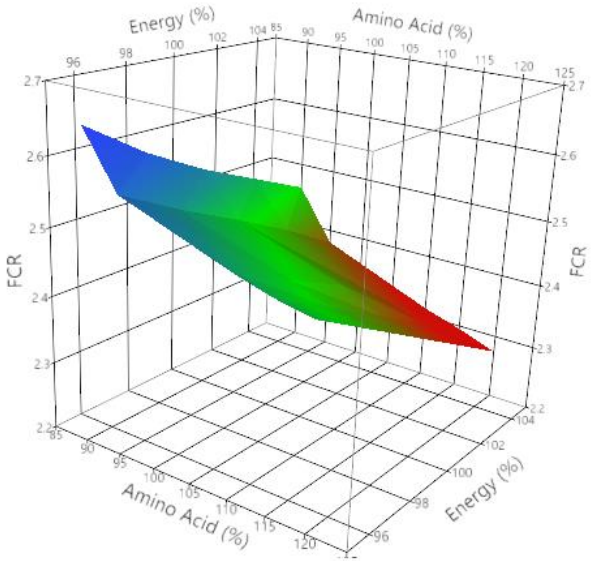
- Higher nutrient densities may achieve higher biological performance but, based on current costs, are outweighed by increase feed cost.
- As energy density increases revenue increases, however feed cost per bird also increases but to a greater degree. Margin per bird decreases at higher energy densities.
- Based on current costs; it may be more prudent to sacrifice FCR to achieve higher margin by reducing energy density relative to the commercial standard.



Farm margin (€/bird)



FCR



Farm margin (€/bird) after feed cost at differing amino acid and energy densities

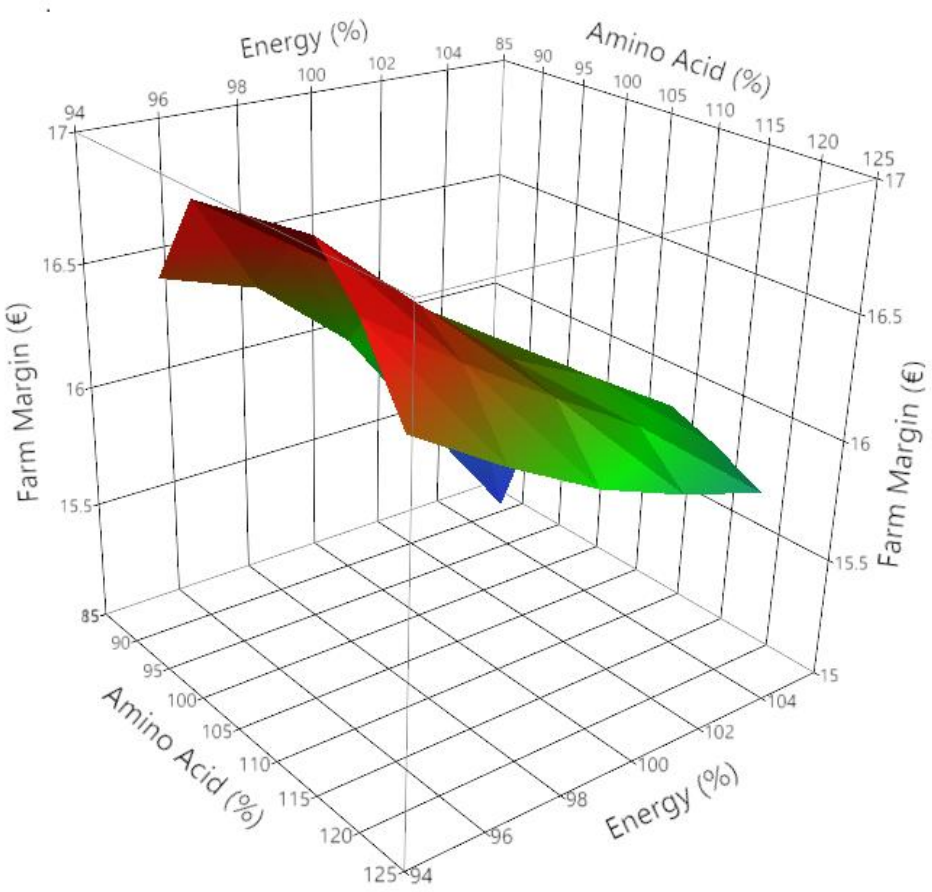
Margin (€/bird)

Amino Acid Density (%)							
90	95	100	105	110	115	120	
15.0	15.4	15.7	15.8	15.9	15.8	15.7	105.0
15.5	15.8	16.0	16.0	16.1	16.0	15.8	102.5
16.0	16.2	16.4	16.4	16.3	16.2	16.0	100.0
16.4	16.5	16.6	16.7	16.6	16.5	16.2	97.5
16.5	16.7	16.9	17.0	16.9	16.7	16.4	95.0

Energy (%)

+€0.6

Margin (€/bird)



[1]*revenue based on Euro 1.71/kg liveweight*

Processing revenue (€/bird) at differing amino acid and energy densities

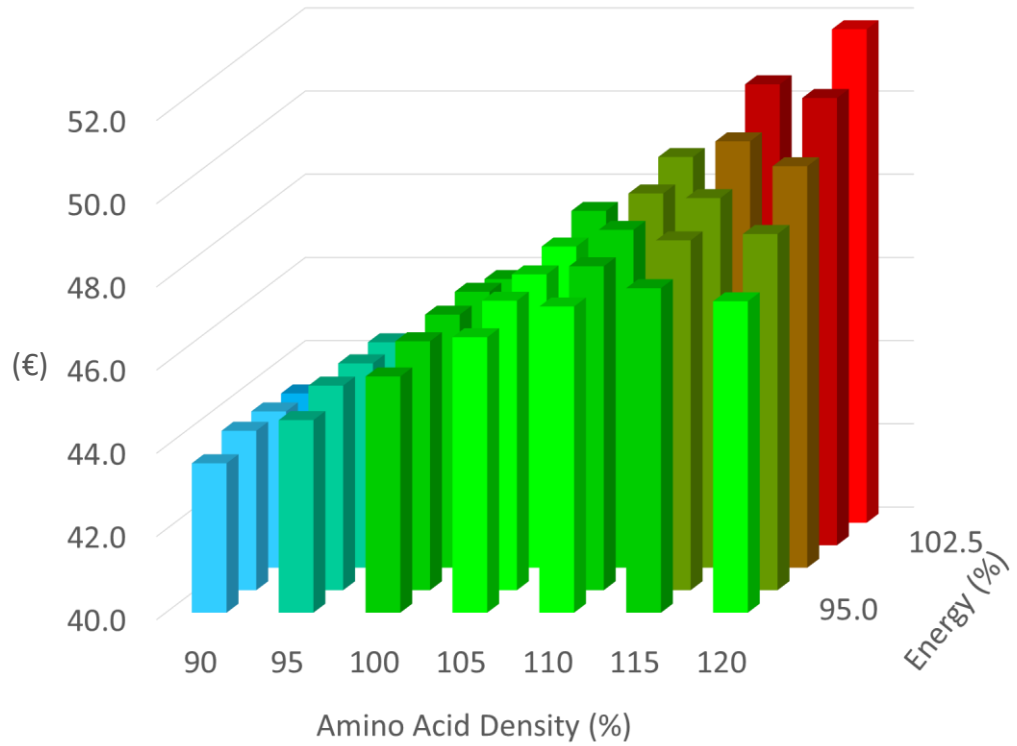
Revenue (€/bird)

Amino Acid Density (%)								
90	95	100	105	110	115	120		
42.7	44.3	45.9	47.5	48.8	50.5	51.9	105.0	Energy (%)
43.6	44.9	46.1	47.2	48.5	49.7	50.8	102.5	
43.8	44.9	46.1	47.1	48.1	48.9	49.7	100.0	
43.8	44.9	46.0	47.0	47.8	48.4	48.6	97.5	
43.6	44.6	45.7	46.6	47.4	47.8	47.5	95.0	

+€9.2

Processing revenue is very responsive to nutrient density

***Revenue (€/bird)**



**revenue based on Euro 7.45/kg breast meat*

Processing margin (€/bird) at differing amino acid and energy densities

Margin (€/bird)

Amino Acid Density (%)							
90	95	100	105	110	115	120	Energy (%)
23.8	24.7	25.5	26.1	27.1	27.8	28.3	102.5
24.4	25.2	26.0	26.6	27.2	27.5	27.7	100.0
24.8	25.6	26.4	27.0	27.4	27.5	27.2	97.5
25.0	25.8	26.5	27.2	27.6	27.5	26.7	95.0

Optimal Processing Margin

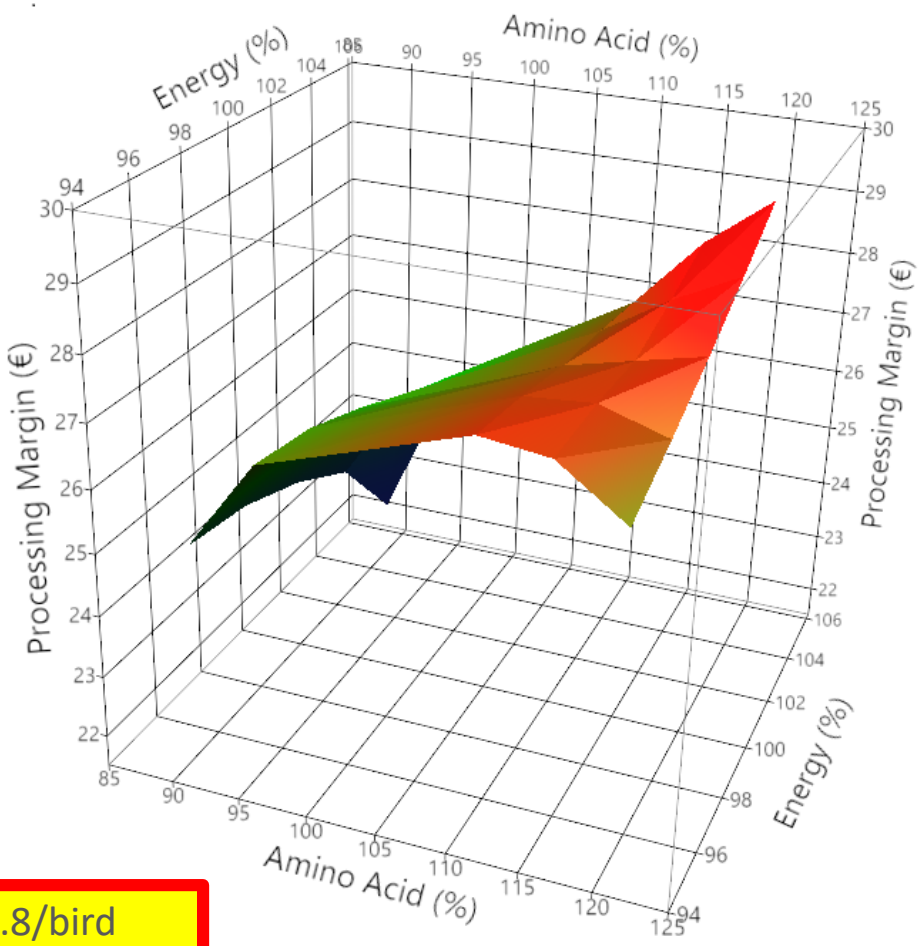
Current

Difference: €3.0/bird

Optimal Farm Margin

Difference: €1.8/bird

Margin (€/bird)



[2]revenue based on Euro 7.45/kg breast meat

Summary: Processing Economics

- Optimal processing margin was achieved at the highest nutrient density.
- This reflects the response of breast meat yield to nutrient density and the higher revenue associated with processed products relative to liveweight.
- The scope for attaining higher margin is significant.
- The evaluation was based on 2023 feed costs.

2021 Feed cost (€/MT) at altering amino acid and energy densities

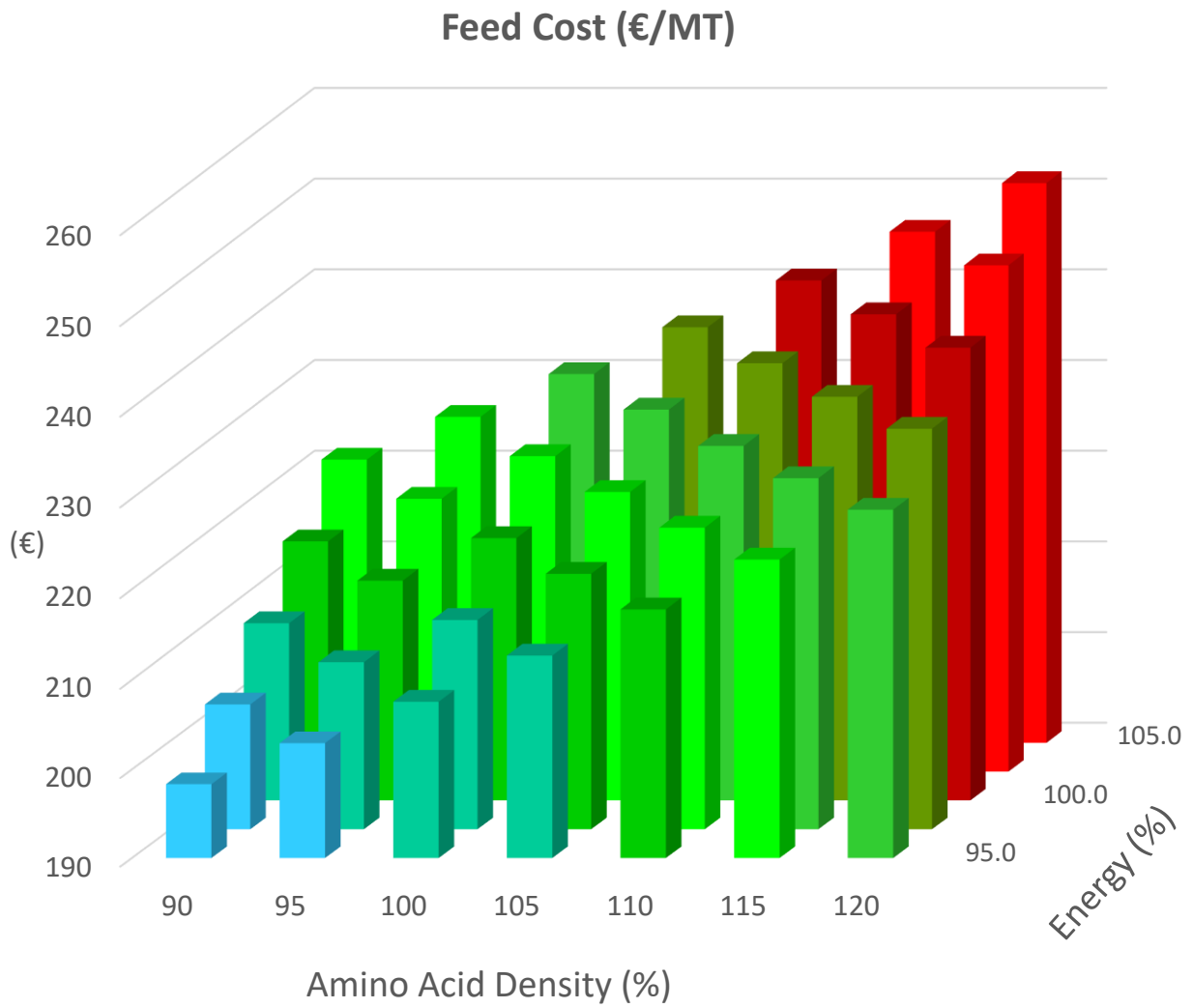
Feed Cost (€/MT)

Amino Acid Density (%)							
90	95	100	105	110	115	120	
221	226	231	236	241	246	252	105.0
216	220	225	230	235	241	246	102.5
210	214	219	224	229	235	240	100.0
204	209	213	218	224	229	234	97.5
198	203	208	213	218	223	229	95.0

Energy (%)

2023 €446

2023 €341



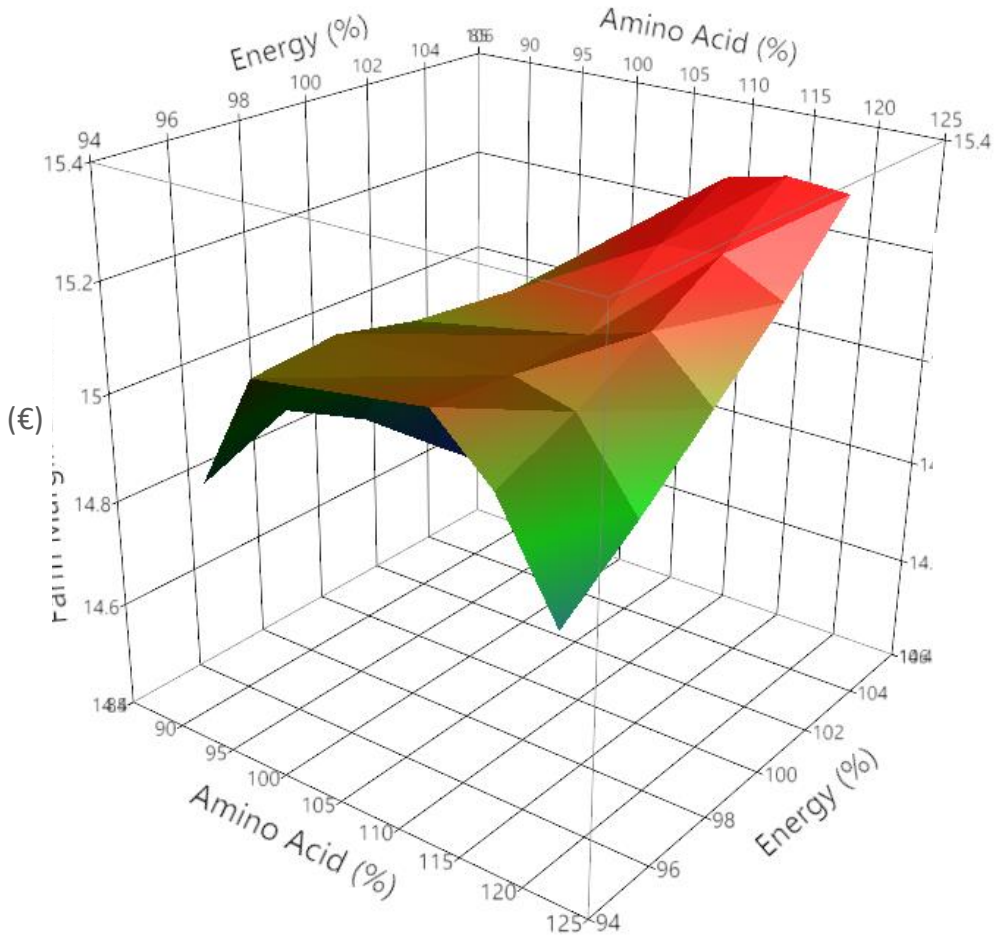
2021 Farm Margin (€/bird) after feed cost

Margin (€/bird)

Amino Acid Density (%)								
90	95	100	105	110	115	120		
14.6	14.8	15.0	15.2	15.3	15.3	15.3	105.0	Energy (%)
14.7	14.9	15.0	15.1	15.2	15.2	15.2	102.5	
14.8	14.9	15.1	15.1	15.1	15.1	15.0	100.0	
14.9	15.0	15.1	15.1	15.1	15.1	14.9	97.5	
14.8	15.0	15.1	15.1	15.1	15.0	14.8	95.0	

Revenue adjusted to reflect 2021 figures.

*Margin (€/bird)



*based on Euro 1.25/kg liveweight

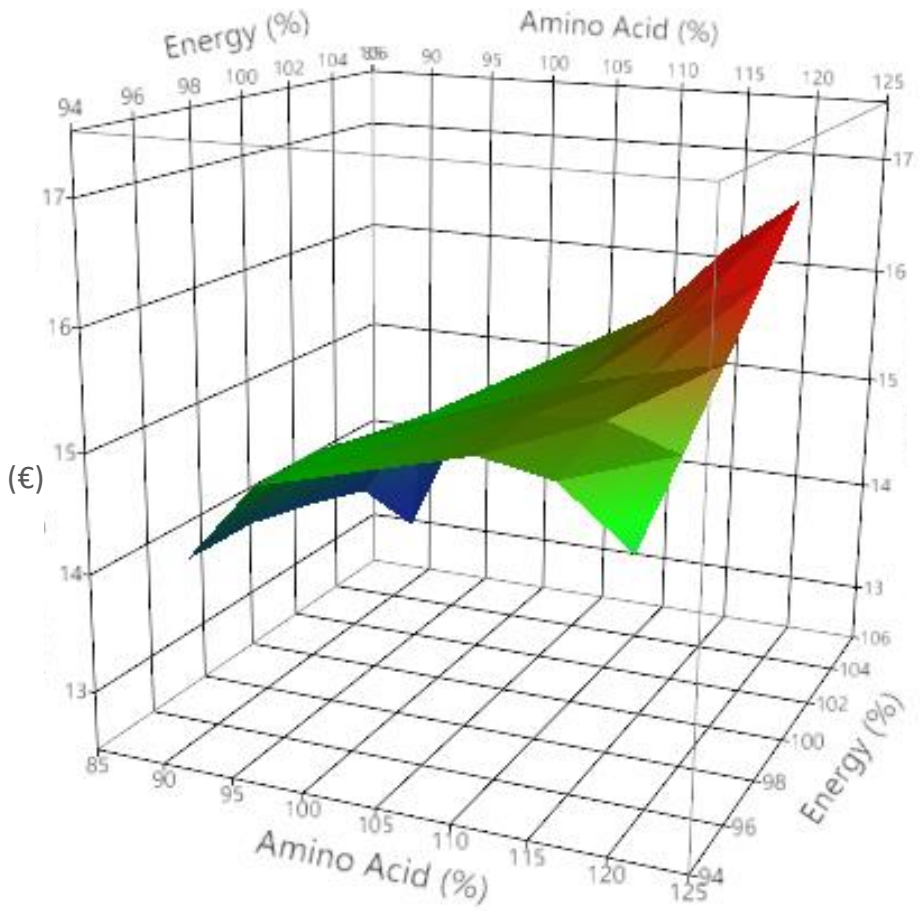
2021 Processing Margin (€/bird) after feed cost

Margin (€/bird)

Amino Acid Density (%)								
90	95	100	105	110	115	120		
13.1	13.7	14.4	15.0	15.5	16.2	16.6	105.0	Energy (%)
13.8	14.2	14.6	14.9	15.5	15.8	16.1	102.5	
13.9	14.3	14.7	15.0	15.3	15.5	15.6	100.0	
14.1	14.5	14.8	15.1	15.3	15.4	15.2	97.5	
14.1	14.4	14.8	15.1	15.3	15.2	14.7	95.0	

Processing margin shows the same trend as 2023 cost base and shows resilience to raw material price change.

*Margin (€/bird)



*based on Euro 4.25/kg breast meat

Summary

- The data demonstrates the ability of the modern bird to respond to a wide range of nutrient levels.
- Liveweight, FCR and breast meat yield are responsive to nutrient density.
- Raw material costs have a significant impact on the optimal diet nutrient density and highlights the importance of nutritionists reviewing feeding programmes especially during periods of volatile raw material prices.
- Optimal economic performance is realised at different nutrient densities and are dependent on the objectives of the business.

Thank you!
and
Thank you to the team!