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Comparison of the performance of six artificial feeds for Dover sole (*Solea solea*)

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Summary

The performance of six artificial feeds for Dover sole (*Solea solea*) was investigated. The tested feeds are Nutreco Aroma 1, Nutreco Aroma 2, Nutreco Control, Nutreco Gemma 1.8 and two anonymous feeds. All feeds were tested in triplicates. 18 glass tanks were each stocked with 20 Dover sole with an average initial weight of 79.1g. Individual weights of all fish were measured on day 1 and day 56 of the experimental period. After day 56 the experiment was continued until day 83 for the feeds Nutreco Aroma 1, Aroma 2 and Control. On day 83 all individual weights of fish still in the experiment were determined. Based on the measured individual weights and the feed load, SGR and FCR were determined for all treatments.

For period 1 (day 1 to day 56) no significant differences were found for the SGR of all four Nutreco feeds in the experiment. On average the SGR for all four Nutreco feeds was 0.54%BW/d. All four Nutreco feeds performed significantly better than Anonymous feed 1, who yielded an SGR of respectively 0.40%BW/d. In addition Nutreco Aroma 2 yielded a significantly better SGR than Anonymous feed 2, which yielded an SGR of 0.47%BW/d.

For period 2 (day 57 to 83) and overall (day 1 to day 83) no significant differences were found for the SGR of Nutreco Aroma 1, Aroma 2 and Control. Average SGR of the three feeds found are respectively 0.57%BW/d for period 1 and 0.55%BW/d overall.

It is concluded that among the Nutreco feeds none of the feeds yields better performance in terms of SGR and FCR than any of the other Nutreco feeds.

1. Introduction

This document reports the performance of six artificial diets for Dover sole, which has been assessed in a feeding trial. The feeding trial had two contractors: Nutreco and Solea bv. As a result some of the diets in the experiment will be kept anonymous to each of the contractors. This report has been written for Nutreco.

2. Materials and methods

2.1 Experimental set up

Facility
The experimental facility consists of a recirculation system with a total of 18 glass tanks. The tanks have a volume of 165 l each and bottom surface area of 0.46 m^2. The water treatment system consists of two lamella separators, with a total sedimentation area of 15.6 m^2 and a trickling filter with a volume of 3.4 m^3. The salinity was kept at 24.9 ± 1.8 ‰ and the water temperature at 20.9 ± 0.9 °C throughout the experimental period.

Fish
The sole (*Solea solea)* used in the experiment are the offspring of the sole broodstock kept at The Netherlands Institute for Fisheries Research. The sole used in this experiment originate from a group of sole consisting of several batches that hatched in spring 2001. After the yolk sac period the sole larvae were fed enriched artemia and later weaned on a complete dry diet. The total group consists of approximately 1500 fish. From this group the 360 required experimental fish were selected. Equally sized fish were selected to form uniform groups for the different treatments. Fish suffering from tail or fin rot, and other deformities were excluded from the experiment. Table 1 presents the average initial weights.

Set up
Eighteen tanks were stocked with 20 fish. The fish were not weighed at this point and uniformity of the groups was judged by eye. The first seven days after transferring the fish to the experimental facility served as an acclimatization period. During six days the fish were fed Gemma 1.8mm. On the seventh day after transfer all fish were weighed individually. The eighth day after transfer, feeding of the experimental diets was started. This day is the actual starting day of the experiment and will be referred to as Day 1.

Experimental diets and feeding
The diets tested are
1. Nutreco experimental sole diet Aroma 1
2. Nutreco experimental sole diet Aroma 2
3. Nutreco experimental sole diet Control
4. Gemma 1.8mm
5. Anonymous feed 1
6. Anonymous feed 2

The experimental diets were tested in triplicates. Each experimental diet was assigned to three tanks using a randomized complete block design (Gomez and Gomez, 1984).
Feed was administered to the tanks by belt feeder, continuously for 20 hours per day. The belt feeders were refilled each morning around 10:00 am during the experimental period.
In order to ensure ad libitum feed intake the fish were fed just over satiation. Uneaten feed in the tank was used as an indicator for feeding over satiation. As a starting point one feeding schedule was calculated for all tanks based on a feeding level of 1%/day, an expected FCR of 1.5 and the initial average weight of all fish in the experiment of 79.1 g. Daily the amount of uneaten feed was quantified as “a lot”, “average” or “little” in each tank. Based on this observation the amount of feed for the next day according to the feeding schedule was either decreased, kept according to schedule, or increased. This way the amount of feed was adjusted daily to the demand of the fish.
Each tank was equipped with a central bottom drain around which a plastic ring was placed. This ring prevented uneaten feed to be removed from the tank by the water flow, thereby making it possible to monitor uneaten feed.

Every day uneaten feed was removed from the tank by removing the plastic ring, and draining approximately 10 cm of the water via the central outlet. Meanwhile the tank bottoms were cleaned using a brush.
Table 1 Provides a summary of the experimental set up.

Table 1: Experimental set up.

Tank	Experimental diet	Initial average weight (g)
1	Nutreco Aroma 2	67.3
2	Nutreco Aroma 1	77.4
3	Nutreco Control	73.5
4	Gemma 1.8	76.9
5	Anonymous 2	71.2
6	Anonymous 1	86.1
7	Anonymous 1	83.2
8	Nutreco Aroma 2	78.6
9	Nutreco Control	82.6
10	Gemma 1.8	79.3
11	Anonymous 2	69.8
12	Nutreco Aroma 1	87.7
13	Nutreco Aroma 2	75.0
14	Anonymous 2	80.3
15	Nutreco Aroma 1	94.9
16	Anonymous 1	87.5
17	Nutreco Control	72.7
18	Gemma 1.8	84.2

Experimental period
The experimental period was divided in two parts. The first period lasted from day 1 to day 56. After day 56 the experiment was terminated for experimental feeds 4, 5 and 6 but continued for the remaining three of the six experimental feeds, 1, 2 and 3, for another 27 days. The experiment was terminated after 83 days.

Period 1: Day 1 to 56, all feeds included
Period 2: Day 57 to 83, Nutreco Aroma 1, Nutreco Aroma 2, Nutreco Control.

2.2 Recordings, measurements and calculations

Water quality
The following water quality parameters were recorded:
?? Salinity and water temperature (WTW LF 197), approximately every second day;
?? Dissolved oxygen (WTW OXI 196), weekly;
?? Ammonia (Merck 1.M544.0001), twice during the experimental period
?? Nitrite (Merck 1.M776.0001), twice during the experimental period.

Fish
At day 1 and day 56 of the experimental period the biomass of all individual fish was determined. At day 83 the biomass of all individual fish was determined for the tanks 1, 2, 3, 8, 9, 12, 13, 15 and 17. Mortalities were recorded daily.

Feed
The amount of feed administered to the tanks was recorded daily. The amount of uneaten feed was quantified as described above.

Specific growth rate and feed conversion rate
The SGR was calculated as follows:
Specific Growth Rate (%/day) SGR = $(\ln(W_t) - \ln(W_0))$* **Error!**

Feed Conversion Rate (kg/kg) **Error!**

Feeding Level (%/day) **Error!**

Where: W_0 = total biomass at day 1
W_t = total biomass at day t
T = number of feeding days

Log A = 1.903*logL – 0.484 (Howell, 1998)

met: L = totale lengte tong
A = oppervlak van de bovenzijde van tong

Coefficient of variation for weight (%) **Error!**

Surface area sole (cm^2/individual) $A = 6.0487 * W^{0.6467}$

Where: A = Surface area per individual sole (cm^2)
W = Individual average weight (g)

Mortality occurred during the experiment in a number of tanks. Mortality was taken into account when calculating the SGR and FCR as follows. Based on the initial individual weights as determined on day 1 of the experiment and the weight of the mortality, the initial weight of the dead fish could be determined. The total initial biomass in a tank (W_0) was then reduced with the initial weight of the dead fish.

Statistics
The differences between mean SGR and FCR for each experimental diet are tested for significance using One-Way ANOVA combined with a Least Square Differences test at a significance level of 0.05. All statistics were performed using SPSS 10.0 for Windows.

3. Results

3.1 General

Raw data are available in Appendix A.
The results will be reported for each period of the experiment. In addition, overall results, day 1 till day 83, will be reported for the Nutreco experimental feeds.
For both SGR and FCR the average results of three replications for each experimental feed and the results yielded for each individual experimental unit are presented.

3.2 Water quality

Water quality parameters are presented in Table 2 as the average of all measurements for each parameter plus the standard deviation.

Table 2: Water quality during the experimental period

Parameter	Average + standard deviation	Number of samples
Salinity (‰)	24.9 ± 1.78	82
Temperature (°C)	20.9 ± 0.94	82
Dissolved oxygen (mg/l)	7.89 ± 1.6	12
Ammonia (mg NH_4^+-N/l)	0.35 ± 0.05	2
Nitrite (mg NO_2^-N/l)	0.46 ± 0.01	2

3.3 Mortality

The mortality that occurred during the experiment is presented in Table 3. Only tanks in which mortality occurred are mentioned in Table 3.

Table 3: Mortality during the experiment.
Displayed are the weights (g) of dead fish for each tank.

Experimental day	Tank 5	Tank 6	Tank 8	Tank 16	Tank 18
9		52.9			
10					47.0
14	39.5				
15		35.6			
56		62.5*		113.5*	
60			119.8		
Total number	1	3	1	1	1
Total weight (g)	39.5	151.0	119.8	113.5	47.0

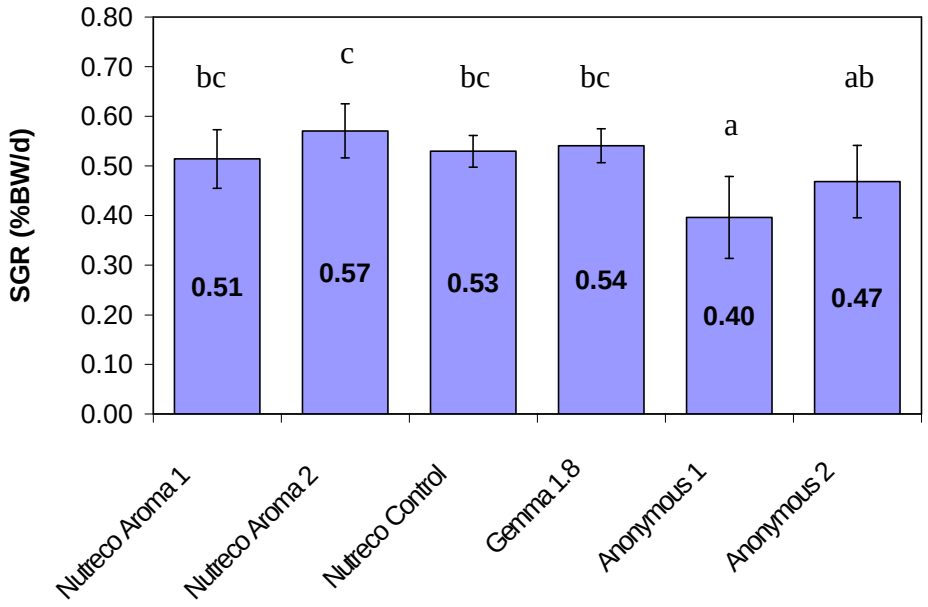
Mortality has been accounted for in calculating the SGR by excluding dead fish as is described in Materials and methods. However the two mortalities that occurred on day 56 of the experiment, marked as *, have not been excluded as day 56 was the last day of the first part of the experimental period.

At the first sampling day, experimental day 56, one fish was found to have jumped from tank 2 to tank 5. Tank 2 contained only 19 fish although no mortalities had occurred, while tank 5 contained 20 fish although one fish had died. In addition, at first sampling tank 5 was found to contain one fish with the exceptionally high weight of 194g. Given the highest initial individual weight in this tank (110g), this fish could not have originated from the stocking of tank 5. Given the highest initial individual weight of the fish in tank 2 (146g) it was highly likely the fish missing from this tank was in fact the large fish in tank 5. Hence it was concluded this fish jumped tanks. Given the position of both tanks, this is very well possible. This fish was excluded from further analyses of the results.

3.4 Specific growth rate

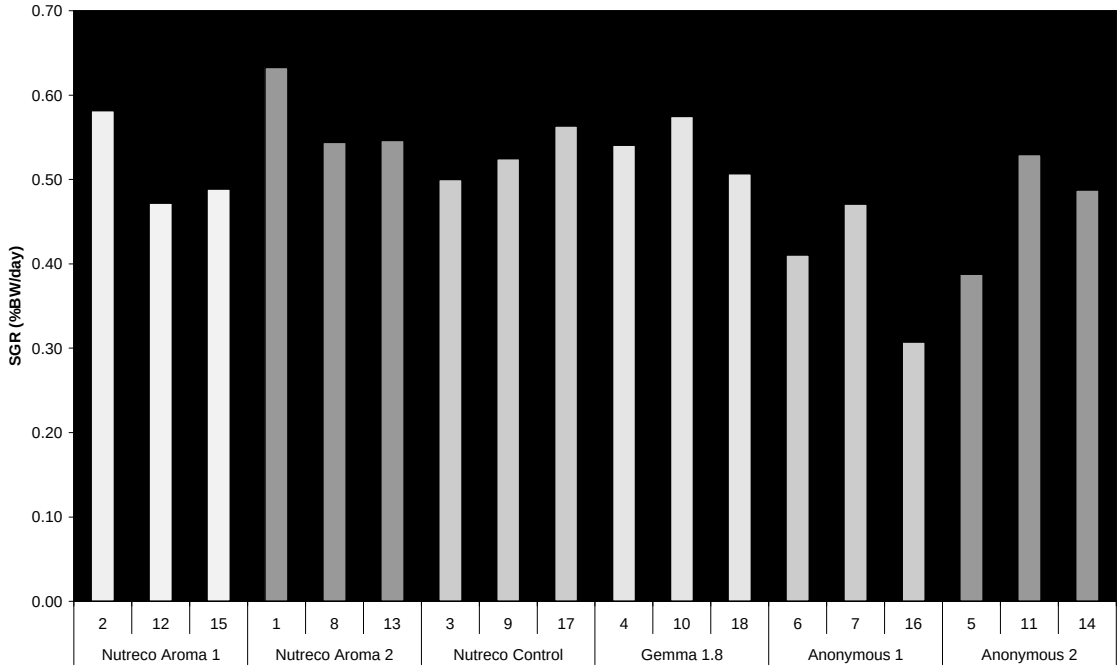
Period 1: Day 1 till day 56, all experimental feeds
Figure 1 provides the average SGR and standard deviation for the period from day 1 till day 56 of the experimental period. Differences in SGR were tested for significance using Oneway ANOVA followed by a Least Square Difference test to identify significant differences. The statistical output is included in Appendix B and displayed in Figure 1.

Figure 1: Average SGR for all the experimental feeds for the period from day 1 till day 56 of the experimental period. SGR values are displayed in the bars. Bars with no common letter are significantly different at the 5% level.



The statistical analysis demonstrates that among each other the experimental Nutreco diets did not yield significantly different SGRs. However all Nutreco diets yield a significantly higher SGR than the experimental diet Anonymous 1. Nutreco Aroma 2 also yields a significantly higher SGR than experimental diet Anonymous 2.
Figure 2 presents the individual SGR obtained for each experimental unit for the same period as Figure 1.

Figure 2: SGR per individual experimental unit for the period from day 1 to day 56. SGR values are displayed above the bars. The X-axis displays tank number and experimental feed.



From Figure 2 it is clear that certain variability in SGR exists among the replications.

Period 2: Day 57 till day 83, Nutreco experimental diets

Figure 3 presents the average SGR and standard deviation of three replications for Nutreco Aroma 1, Aroma 2 and Control for the second experimental period: day 57 till day 83.

Differences in SGR were tested for significance using Oneway ANOVA followed by a Least Square Difference test to identify significant differences. The statistical output is included in Appendix B and displayed in Figure 3. The statistical analysis clearly demonstrates that the experimental Nutreco diets did not yield significantly different SGRs in the period from day 57 to day 83.

Figure 3: Average SGR for the experimental feeds Nutreco Aroma 1, Aroma 2 and Control for the period from experimental day 57 till day 83. SGR values are displayed in the bars. Bars with no common letter are significantly different at the 5% level.

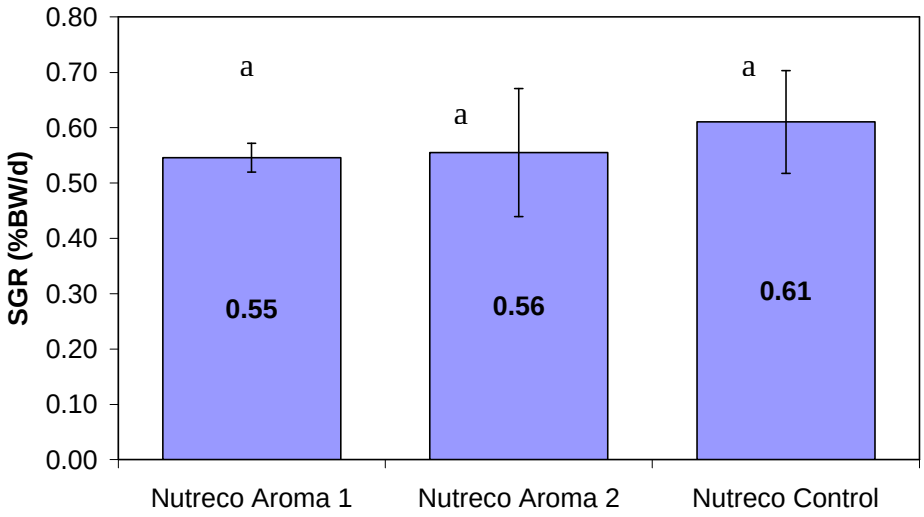
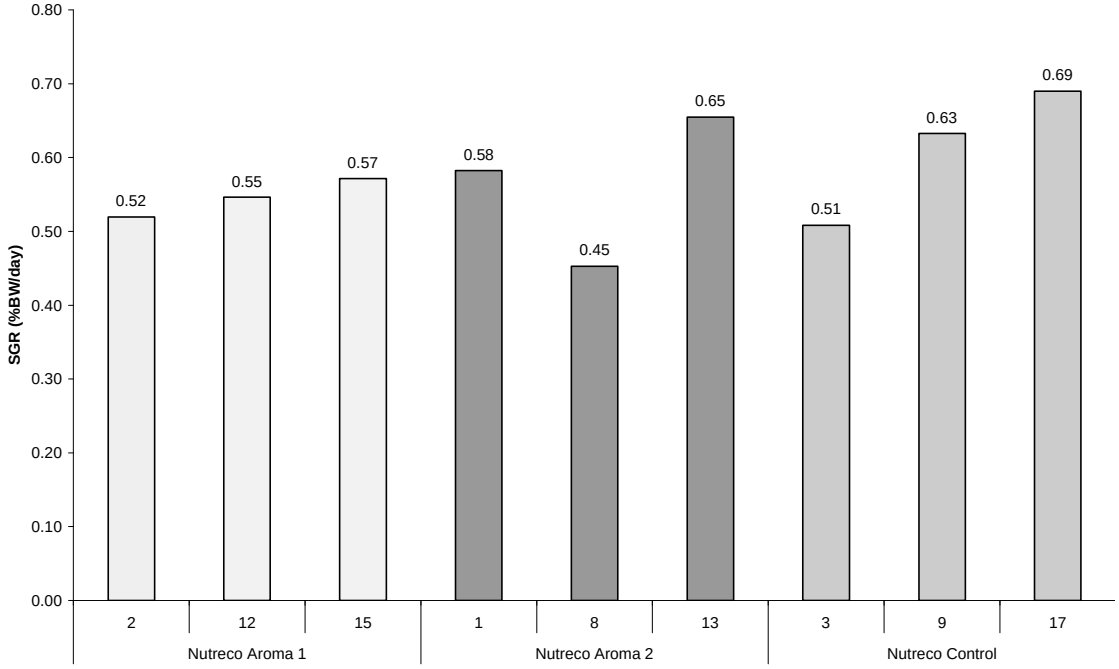


Figure 4 presents the SGR obtained for each individual experimental unit for the three experimental Nutreco feeds in the period from day 57 till day 83.

Figure 4: SGR per individual experimental unit for the period from day 57 till day 83 for the experimental Nutreco feeds. SGR values are displayed above the bars. The X-axis displays tank number and experimental feed.

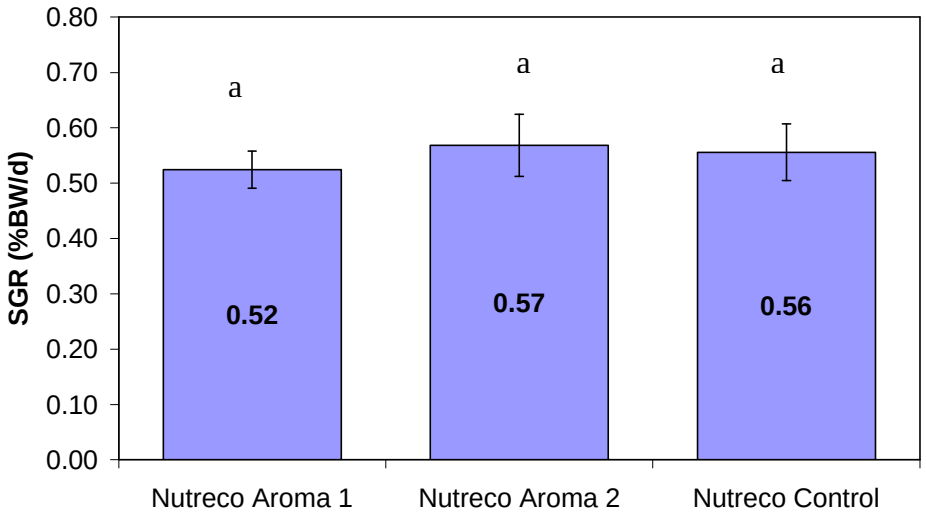


Nutreco Aroma 1 performed, based on the average of the three replications, better during period 2 than period 1. Variation among the replicates for this feed is reduced in period 2 as is clear from comparing the standard deviation presented in Figure 1 and 3 and the SGR data presented in Figure 2 and 4.

Remarkable is that the best performing replicate in period 1, tank 2, is the poorest performing tank in period 2. The other two replicates for this feed both perform better in period 2.
Nutreco Aroma 2 performed, based on the average of the three replications, better during period 2 than period 1. However, in period 2 this feed is no longer the feed with the highest average SGR. In contrast to Nutreco Aroma 1, variation among the replicates for this feed has increased in period 2 as is clear from comparing the standard deviations presented in Figure 1 and 3 and the SGR data presented in Figure 2 and 4. Again the best performing replicate in period 1, tank 1, displays a decreased SGR in period 2. Remarkable is the poor performance of tank 8, which is affecting the average SGR for this feed, as well as the far better performance of tank 13 in period 2 compared to period 1.
Nutreco Control performed, based on the average of the three replications, better during period 2 than period 1. In period 2 this feed yields the highest average SGR. In contrast to the other to feeds, the three replicates for this feed all perform better during period 2 compared to period 1. In addition, the ranking in the performance of the replicates has not changed.

Overall: Day 1 till day 83, Nutreco experimental feeds
For the three experimental Nutreco diets, Aroma 1, Aroma 2 and Control the average SGR and standard deviation have also been calculated for the entire experimental period: day 1 till 83. The results are displayed in Figure 5. Differences in SGR were tested for significance using Oneway ANOVA followed by a Least Square Difference test to identify significant differences. The statistical output is included in Appendix B and displayed in Figure 5.

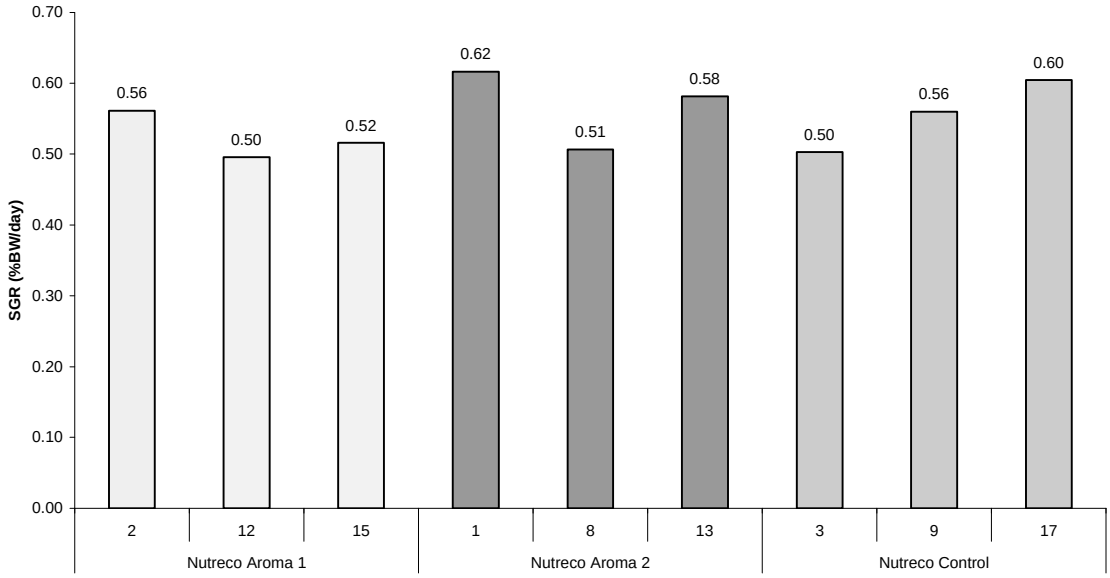
Figure 5: Average SGR and standard deviation for the experimental Nutreco diets for the entire experimental period, day 1 till day 83. SGR values are displayed in the bars. Bars with no common letter are significantly different at the 5% level.



The statistical analysis demonstrates that throughout the entire experimental period, day 1 till day 83, the experimental Nutreco diets did not yield significantly different growth.

Figure 6 presents the SGR obtained for each individual experimental unit for the experimental Nutreco diets throughout the whole experimental period (day 1 till day 83).

Figure 6: SGR per individual experimental unit for the period from day 1 till day 83 for the experimental Nutreco feeds. SGR values are displayed above the bars. The X-axis displays tank number and experimental feed.

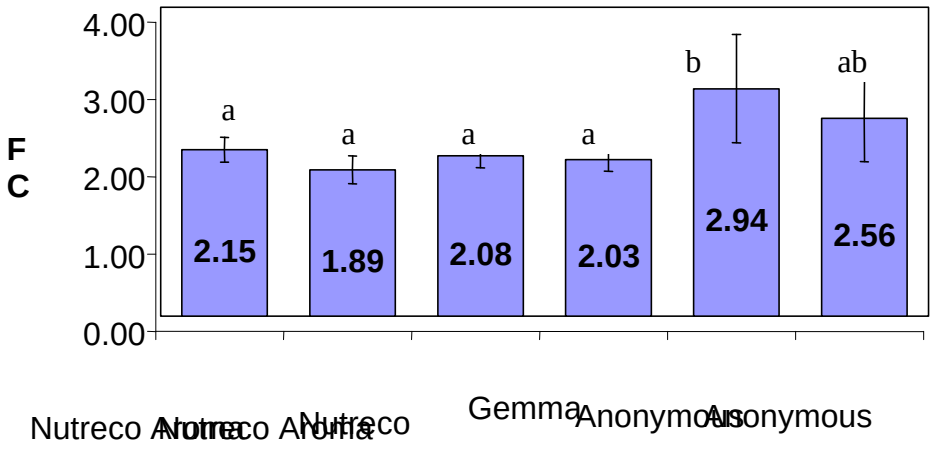


3.5 Feed conversion rate

General
As described in Materials and methods the fish in the experiment were overfed on purpose in order to ensure feeding to satiation. As a result feed was wasted on a daily basis. The FCR obtained in this experiment are therefore overestimated.

Period 1: Day 1 till day 56, all experimental feeds
Figure 7 presents the average FCR and standard deviation for all experimental feeds for the first part of the experimental period: day 1 till day 56.

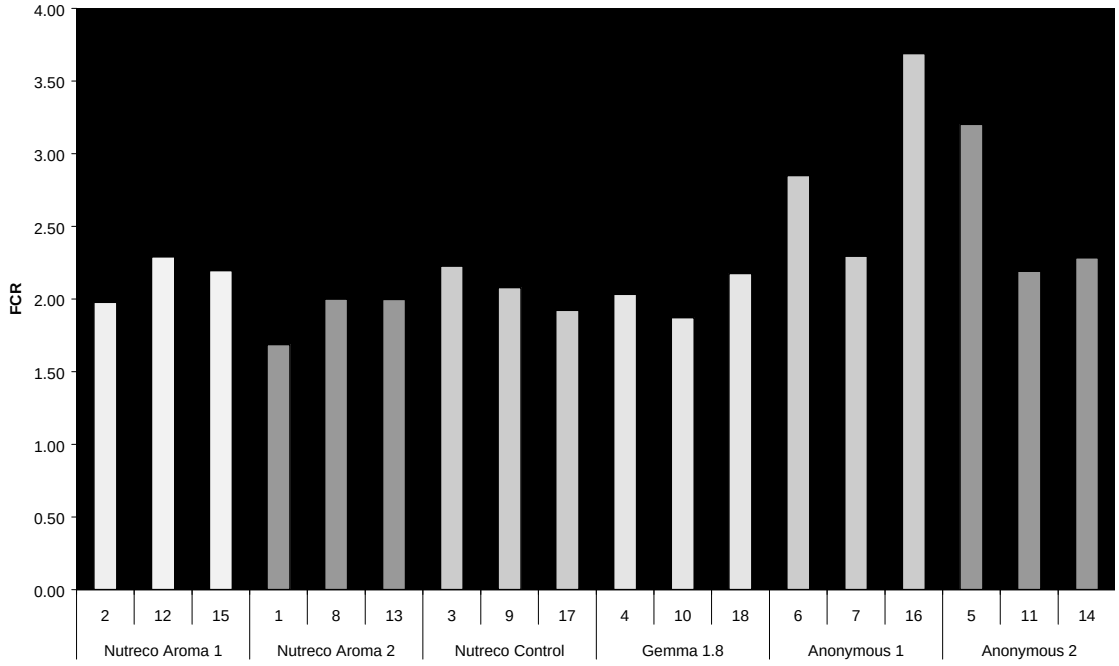
Figure 7: Average FCR for all experimental feeds for day 1 till day 56. FCR values are displayed in the bars. Bars with no common letter are significantly different at the 5% level.



Differences in FCR were tested for significance using One-way ANOVA followed by a Least Square Difference test to identify significant differences. The statistical output is included in Appendix B and displayed in Figure 7. The statistical analysis demonstrates that among each other the experimental Nutreco diets did not yield significantly different FCR. However all Nutreco diets yield a significantly lower FCR than the experimental diet Anonymous 1. The FCR of Nutreco Aroma 2 is almost significantly different from the FCR of experimental diet Anonymous 2.

Figure 8 presents the FCR obtained for each individual experimental unit for the experimental feeds during Period 1 (day 1 till day 57).

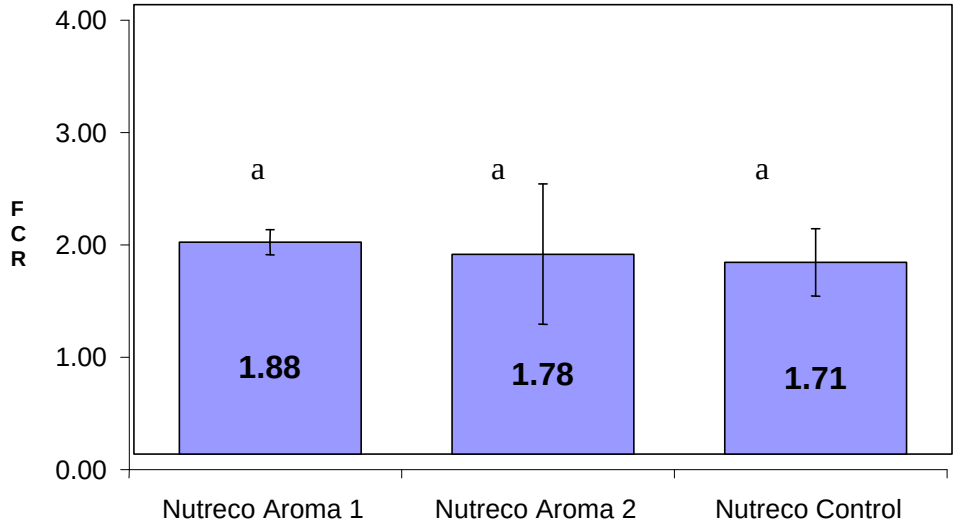
Figure 8: FCR per individual experimental unit for the period from day 1 till day 56 for all experimental feeds. FCR values are displayed above the bars. The X-axis displays tank number and experimental feed.



Period 2: day 57 till day 83, Nutreco experimental feeds

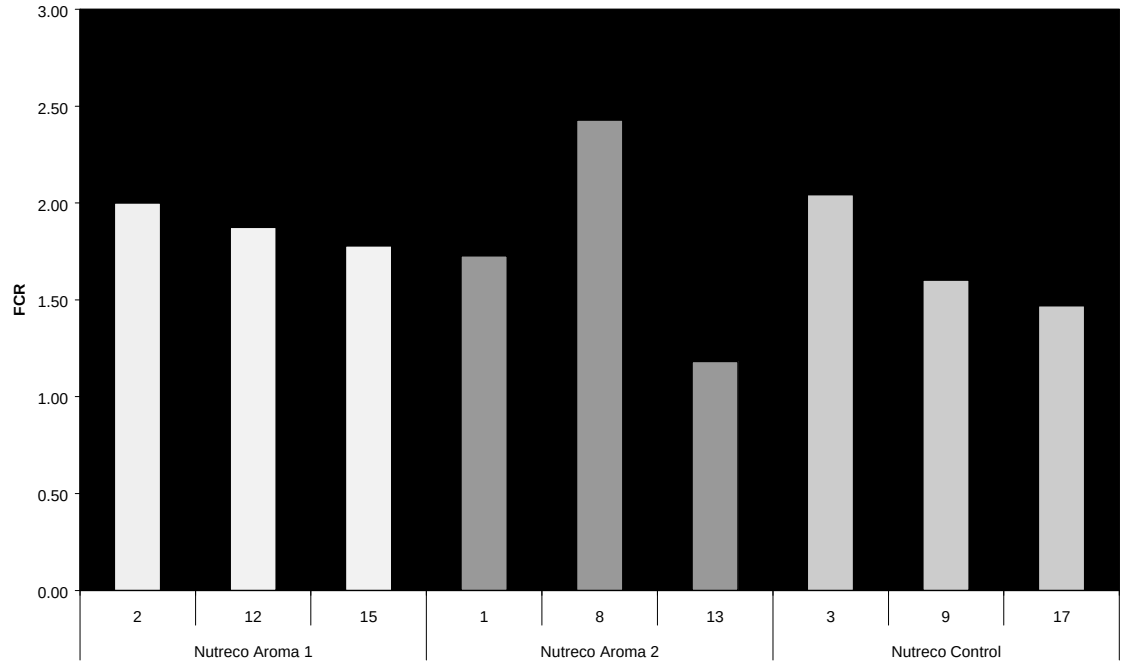
Figure 9 presents the average FCR and standard deviation for the experimental Nutreco feeds for the second part of the experimental period: day 57 till day 83. Differences in FCR were tested for significance using Oneway ANOVA followed by a Least Square Difference test to identify significant differences. The statistical output is included in Appendix B and displayed in Figure 9.

Figure 9: Average FCR for the experimental Nutreco feeds for day 57 till day 83. Values are displayed in the bars.



The statistical analysis demonstrates that the experimental Nutreco diets did not yield significantly different FCR in the period from day 57 to day 83.
Figure 10 presents the FCR obtained for each experimental unit for the three experimental Nutreco feeds in the period from day 57 till day 83.

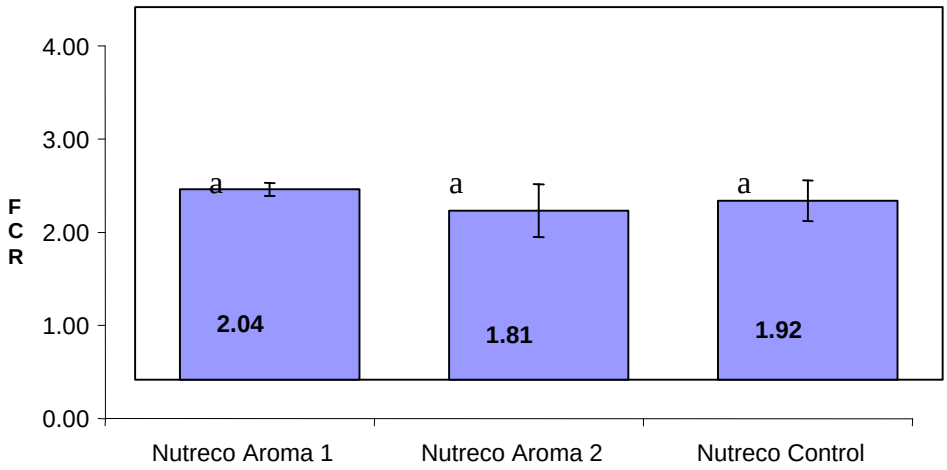
Figure 10: FCR per individual experimental unit for the period from day 57 till day 83 for the experimental Nutreco feeds. FCR values are displayed above the bars. The X-axis displays tank number and experimental feed.



Overall: day 1 till day 83, Nutreco experimental feeds

Figure 11 presents the average FCR and standard deviation obtained for the experimental Nutreco feeds for the entire experimental period: day 1 till day 83. Differences in FCR were tested for significance using Oneway ANOVA followed by a Least Square Difference test to identify significant differences. The statistical output is included in Appendix B and displayed in Figure 11.

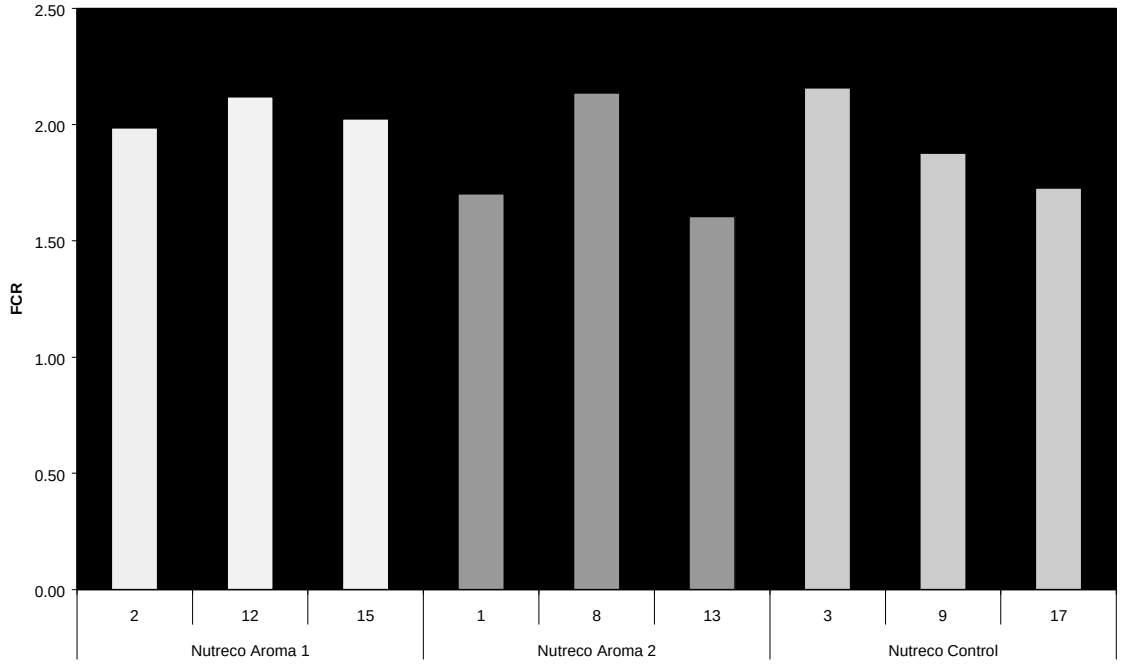
Figure 11: Average FCR for the experimental Nutreco feeds for day 1 till day 83. Values are displayed in the bars.



The statistical analysis demonstrates that throughout the entire experimental period, day 1 till day 83, the experimental Nutreco diets did not significantly different in FCR.

Figure 12 presents the FCR obtained for each individual experimental unit for the experimental Nutreco diets throughout the whole experimental period (day 1 till day 83).

Figure 12: FCR per individual experimental unit for the period from day 1 till day 83 for the experimental Nutreco feeds. FCR values are displayed above the bars. The X-axis displays tank number and experimental feed.



4. Conclusions

Based on the results of this experiment it is concluded that:

- None of the experimental Nutreco feeds (Aroma 1, Aroma 2, Control and Gemma 1.8) yields significantly better specific growth rates and feed conversion rates than any of the other experimental Nutreco feeds.
- All experimental Nutreco feeds yield significantly better SGR and FCR than experimental feed anonymous 1.
- Experimental Nutreco feed Aroma 2 yields a significantly better SGR and an almost significantly better FCR than experimental feed Anonymous 2.

5. Literature

Gomez, K. A., and Gomez, A. A. (1984). *Statistical Procedures for Agricultural Research*, Wiley Interscience, New York.

Appendices

Appendix A Raw data

Table A: Initial individual weights
Table B: Individual weights at first sampling, day 56
Table C: Individual weights at second sampling, day 83
Table D: Overview of total feed load, biomass increase, FCR and SGR for each experimental unit

Appendix B Statistical output

Table A: Initial individual weights

Fish	Tank 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	60.6	67.6	77.8	93.8	36.2	43.4	76.5	83.8	56.2	127.1	42	76.4	91.3	94	77	158.2	60.8	46.9
2	52.9	81.7	54.7	58.5	67.5	57.1	120	44.2	82.6	103.8	78.3	69.4	98.5	51.3	86	102.2	86.8	48.4
3	74	97.7	71.2	110.1	50.9	62.3	79.2	53.2	73.5	58.8	65	100.3	54.3	66.2	128.8	56.3	55.1	51.6
4	59.8	110.2	73.2	75.3	50.5	63.9	93.7	45.9	70.2	46.4	107	65.9	60.3	108	125.5	109.9	48.5	60.3
5	69.3	146.1	100.4	80.3	54.5	70.9	50.4	50	139.9	59.9	52.1	102.7	80.1	68	133.8	53.9	92	60.6
6	48.5	86	74.3	75.7	82.3	71.6	113.4	138.1	89	83.4	70.6	104.7	61.3	82.2	95.1	79.2	47.3	63.3
7	46.8	58.8	62.8	64	73.7	79.1	63.8	115.9	85.4	73.1	68.9	102.9	95.6	48.3	60.5	81.9	148.4	64.2
8	72.1	50.6	86.8	111.8	105.3	79.2	71.3	70.4	86.5	83.9	102.3	98.8	74.4	99.3	92.8	107.2	82.4	70.1
9	102.4	81.5	107.4	60.8	110.1	81.5	86.7	80.1	94.6	79.4	89.2	87.3	82.8	56.3	61.2	78.3	58.7	72.5
10	52	85.7	51.4	72.4	63.6	83.1	103.8	100.4	73.1	61.7	54.1	115.5	79.1	66.8	110.9	69.2	46.5	74.9
11	71.1	79	62.6	73.7	59.3	85.36	80	60	84.2	77.9	55.9	54.1	79.7	71.1	70.7	107.3	54.6	78.1
12	61	118.8	114.8	51.4	46.4	86	98.1	54.9	37.7	61.9	75.4	94.9	70.4	52.9	83.4	90.1	60	79.8
13	51.6	45.4	82	137.7	67.5	89.9	104	53.9	71.8	95.6	72.4	61.5	72.2	100.4	110.6	46	57	82.3
14	85.9	56.8	55.6	58	99.4	91.1	77.4	101.9	75.3	74.1	55.7	107.1	65.2	67	79.7	71.4	54.2	94.6
15	71.6	101	95	82.3	74.2	95.2	60.3	76	97.8	101.8	41.9	63.2	67.5	128.4	114.7	62.5	82.7	97.9
16	46.3	66.8	74.5	53.2	49.6	96.6	77.1	101.3	78.7	112.9	71.3	107.9	106.9	91.3	70.7	52.8	78.7	104.5
17	73.8	61.4	54.4	64	89.3	98.1	81.8	125.6	61.1	75.4	76.2	64.7	70.2	67.2	111.2	116.2	66.8	117.6
18	80.7	70.9	51.3	98.5	92.4	98.2	70.5	56.7	106.8	87.4	67.4	101.6	69.5	95	66.4	102.8	43.2	118.3
19	80.7	97.2	58.7	59.9	65.2	103.9	89.5	91.8	97.3	53.2	50	99.9	53.4	131.8	139.9	94.2	112.1	128.1
20	84.1	54.1	60.2	57.4	50.2	114.3	67.4	67.8	89.5	69	100	75.3	66.8	60.5	80	110.6	117.3	132.4
Average	**67.3**	**77.4**	**73.5**	**76.9**	**71.2**	**86.1**	**83.2**	**78.6**	**82.6**	**79.3**	**69.8**	**87.7**	**75.0**	**80.3**	**94.9**	**87.5**	**72.7**	**84.2**
Standard deviation	15.2	20.9	19.1	23.0	20.1	13.9	18.0	27.9	20.9	20.8	18.9	19.2	14.5	24.7	25.2	27.7	27.7	25.8

Fish excluded from further data processing (marked in grey):

Fish 5, tank 2 Excluded as this fish jumped to tank 5

Fish 1, tank 5 Excluded due to mortality

Fish 1, 2, tank 6 Excluded due to mortality

Fish 1, tank 18 Excluded due to mortality

Please note that equal fish numbers in Table A, B and C do not represent the same fish

Table B: Individual weights at the end of Period 1, Day 56.

	Tank																	
Fish	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
1	69.6	167.3	132.2	81.5	82.7	153.9	101.2	141.1	109.0	103.7	118.5	126.6	120.8	109.0	119.3	93.0	68.6	
2	97.9	122.1	110.6	78.1	92.6	100.3	102.5	171.3	102.0	71.9	104.6	59.4	117.4	112.7	129.0	129.0	139.7	
3	91.3	117.3	83.3	108.1	79.8	112.9	82.5	85.5	110.7	63.9	59.4	138.4	103.4	63.5	181.1	95.3	112.8	
4	79.7	93.6	102.4	123.5	53.3	108.6	121.8	69.1	107.1	116.8	103.5	92.4	82.6	72.7	172.6	60.0	78.4	
5	98.8	116.8	103.8	107.7	96.5	152.0	98.9	119.8	123.2	107.3	83.1	125.2	95.8	79.7	91.5	181.1	98.4	
6	78.9	126.4	79.3	91.9	49.2	121.6	119.9	124.0	157.4	151.8	79.5	145.2	131.8	82.4	168.3	124	132.2	
7	67.4	70.5	115.7	172.5	73.2	111.1	142.3	143.3	83.8	125.4	130.9	137.4	67.2	94.4	83.1	141.3	195.0	
8	108.1	66.5	136.0	132.5	79.0	117	147.5	80.3	124.1	119.5	90.5	131.1	87.8	62.2	109.7	91.9	69.4	
9	107.2	144.5	73.7	96.6	70.6	112.9	93.2	99.6	111.0	122.1	76.8	121.7	89.8	141.4	114.9	68.3	149.0	
10	128.2	80.0	72.8	95.1	79.8	87.2	126.5	86.7	147.5	116.5	119.3	130.0	150.7	97.0	120.7	95.5	67.9	
11	117.6	187.7	116.6	93.0	96.2	112.2	95.8	67.4	129.2	81.7	102.8	147.7	117.0	98.1	145.1	87.3	98.7	
12	78.6	109.9	76.1	77.6	193.9	100.6	123.8	77.0	135.5	100.0	82.0	132.2	106.4	108.7	158.6	116.9	67.3	
13	74.7	50.1	74.4	85.5	96.1	98.6	142.5	71.6	48.8	86.8	125.8	63.7	103.9	73.6	112.6	130.6	128.9	
14	93.9	91.7	59.6	103.4	82.4	91.4	107.7	68.3	113.9	108.7	93.6	100.8	97.7	132.9	91.1	114.1	79.3	
15	108.4	113.7	148.1	160.7	137.9	103.8	75.7	126.3	123.2	100.4	77.4	91.0	73.9	125.6	96.6	88.7	95.1	
16	94.2	109.0	71.7	86.3	87.8	97.4	100.7	84.2	95.8	117.7	112.2	115.4	106.3	121.7	120.2	58.2	58.5	
17	70.6	73.4	92.2	100.9	65.3	107.2	120.3	123.4	125.2	122.9	100.2	115.0	82.5	174.7	67.3	102.8	94.3	
18	127.2	127.7	66.5	80.0	147.5	62.5	83.6	153.6	110.0	141.9	91.3	72.5	99.2	98.8	146.5	83.2	125.4	
19	94.9	69.3	113.6	125.7	87.4		59.4	163.7	83.1	75.7	77.2	113.6	96.5	168.7	148.2	113.5	62.5	
20	130.1		115.4	82.3	122.6		121.4	75.8	74.8	154.3	48.9	125.2	105.5	92.7	120.6	103.9	70.7	
Average	**95.9**	**107.2**	**97.2**	**104.1**	**88.4**	**108.4**	**108.4**	**105.9**	**110.8**	**109.5**	**93.9**	**114.2**	**101.8**	**105.5**	**124.9**	**103.9**	**99.6**	**1**
Stdev	20.0	35.6	25.7	26.7	25.2	21.0	23.4	35.5	25.3	25.0	21.6	26.2	19.6	31.6	31.3	29.1	36.0	

Missing data:

Tank 2, Fish 20	Jumped to tank 5
Tank 6, Fish 19, 20	Previously excluded due to mortality
Tank 18, Fish 20	Previously excluded due to mortality

Mortality on the day of sampling, included in further data processing:

Tank 6, Fish 18

Tank 16, Fish 20

Fish excluded from further data processing (marked in ye in grey)

Tank 5, Fish 12	Fish jumped from tank 2
Tank 8, Fish 5	Excluded due to mortality

Please note that equal fish numbers in Table A, B and C do not represent the same fish

Table C: Individual weights at the end of Period 2, Day 83.

	Tank								
Fish	**1**	**2**	**3**	**8**	**9**	**12**	**13**	**15**	**17**
1	153.7	145.6	65.1	86.1	149.1	135.1	128.8	92.0	146.9
2	112.5	57.2	84.6	93.3	153.2	176.0	86.0	196.8	111.4
3	111.6	122.6	116.5	123.6	113.9	163.3	103.8	173.7	85.0
4	93.9	103.6	153.8	171.2	139.1	150.0	140.9	214.6	90.6
5	119.4	133.4	89.6	163.6	174.7	150.5	133.9	144.0	84.6
6	80.1	77.0	86.2	135.3	159.7	141.8	78.6	194.5	113.4
7	121.6	101.3	102.1	99.6	133.7	108.7	116.4	136.1	79.2
8	102.1	148.0	130.0	121.9	151.4	52.4	134.9	106.8	167.1
9	84.9	79.4	86.3	79.7	106.6	143.1	98.0	109.4	140.0
10	86.5	85.3	72.7	175.2	160.4	147.6	114.6	113.9	69.8
11	115.4	203.5	141.3	88.4	94.2	172.0	181.1	149.1	129.6
12	82.8	68.8	98.2	97.9	175.1	140.2	103.7	131.2	156.1
13	93.3	145.9	139.3	197.3	118.9	78.6	123.1	124.4	120.8
14	88.2	218.3	96.8	103.7	143.1	109.3	109.6	145.3	92.4
15	130.5	106.6	154.3	151.8	60.4	152.7	114.3	184.8	83.9
16	113.0	135.9	64.7	98.3	131.6	72.7	142.5	172.8	180.4
17	110.3	124.3	171.2	119.1	130.2	124.2	145.8	134.5	236.9
18	146.7	124.4	137.9	78.2	89.5	163.0	150.9	73.7	139.6
19	165.8	163.1	120.2	89.5	123.7	129.5	99.6	147.7	82.2
20	131.3		119.0		119.5	136.8	123.5	168.1	87.1
Average	**112.2**	**123.4**	**111.5**	**119.7**	**131.4**	**132.4**	**121.5**	**145.7**	**119.9**
Stdev	24.4	42.8	31.5	36.2	29.3	33.2	24.3	37.1	42.7

Missing data

Tank 2, Fish 20 Previously excluded due to mortality

Tank 8, Fish 20 Previously excluded due to mortality

Please note that equal fish numbers in Table A, B and C do not represent the same fish

Table D: Overview of feedload, biomass increase, FCR and SGR for all experimental units.

Feed	Tank	Feedload (g)			Total biomass increase (g)			FCR (g/g)			SGR (%BW/d)		
		Period 1	Period 2	Overall	Period 1	Period 2	Overall	Period 1	Period 2	Overall	Period 1	Period 2	Overall
Nutreco Aroma 1	2	1120	614	1733	566	307	873	1.98	2.00	1.99	0.58	0.52	0.56
	12	1214	680	1895	530	363	893	2.29	1.87	2.12	0.47	0.55	0.50
	15	1314	741	2055	598	417	1015	2.20	1.78	2.03	0.49	0.57	0.52
Nutreco Aroma 2	1	965	564	1529	572	326	898	1.69	1.73	1.70	0.63	0.58	0.62
	8	1120	635	1755	560	262	822	2.00	2.43	2.14	0.54	0.45	0.51
	13	1071	584	1655	537	494	1031	2.00	1.18	1.61	0.55	0.65	0.58
Nutreco Control	3	1058	584	1642	475	286	761	2.23	2.04	2.16	0.50	0.51	0.50
	9	1172	662	1834	564	413	977	2.08	1.60	1.88	0.52	0.63	0.56
	17	1036	600	1635	539	408	947	1.92	1.47	1.73	0.56	0.69	0.60
Gemma 1.8	4	1106	-	1106	544	-	-	2.03	-	-	0.54	-	-
	10	1127	-	1127	602	-	-	1.87	-	-	0.57	-	-
	18	1142	-	1142	525	-	-	2.18	-	-	0.51	-	-
Anonymous 1	6	1143	-	1143	401	-	-	2.85	-	-	0.41	-	-
	7	1153	-	1153	502	-	-	2.30	-	-	0.47	-	-
	16	1211	-	1211	328	-	-	3.69	-	-	0.31	-	-
Anonymous 2	5	1051	-	1051	328	-	-	3.20	-	-	0.39	-	-
	11	1056	-	1056	482	-	-	2.19	-	-	0.53	-	-
	14	1152	-	1152	505	-	-	2.28	-	-	0.49	-	-

Period 1: Day 1 to Day 56
Period 2: Day 57 to day 83
Overall: Day 1 to day 83