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A field trial on the effects of algae addition to calf feed. Project T2014

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Contents

Summary

This report describes a field trial that took place between 1 July and 2 October 2015 at a Dutch rose veal farm in which a group of 30 calves was fed with formula milk of which 2% of the dry matter was substituted with concentrated freshwater algae. The control group consisted of 25 calves. The farm owners collected the data, which were statistically analyzed and reported at ACRRES. During the trial the following parameters were monitored: calf weight, amounts of formula milk, water, solid feeds, feed additions and medication, deviations in manure structure, and disease incidence. Individual calf weights were determined at arrival and four weighing dates. The main conclusion of this field trial is that the addition of algae to the formula milk of rose veal calves during a period of 44 to 51 days did not have a statistically significant effect on calf weight increase up to 13 weeks after the start of the trial. Feed conversion in the first 12-19 days was not different between groups as there was no effect of formula milk amount on calf weight. Solid feed conversion in the last eight weeks of the trial was not different for algae and control group. Algae can thus be added to the diet of veal calves at an inclusion percentage of 2% of the formula milk dry matter without affecting weight increase or feed conversion of formula milk or solid feeds. There was no significant effect (P=0.055) on calf health (incidences of diarrhea and ‘not drinking’) but the results justify further research on the effect of algae addition to calf feeds on calf health. This should be performed under optimized trial conditions, as during this trial some points for improvement were noticed.

Nederlandse samenvatting

Dit rapport beschrijft een praktijkproef die uitgevoerd werd tussen 1 juli en 2 oktober 2015 bij een Nederlandse rosé vleeskalvermesterij. In deze proef werd een groep van 30 kalveren gevoerd met kunstmelk waarvan 2% van de droge stof vervangen werd door ingedikte zoetwateralgen. De controlegroep bestond uit 25 kalveren. De kalvereigenaren verzamelden de data, die vervolgens statistisch geanalyseerd en gerapporteerd zijn bij ACRRES. Gedurende de proef werden de volgende parameters bijgehouden: kalvergewicht, hoeveelheden kunstmelk, water, vaste voeders, voedertoevoegingen/ preparaten en medicijnen, afwijkingen in meststructuur en ziektes. Individuele kalvergewichten werden bepaald bij de start van de proef en op vier weegdatums. De belangrijkste conclusie van dit praktijkonderzoek is dat het toevoegen van algen aan de kunstmelk van rosé kalveren gedurende een periode van 44 tot 51 dagen geen statistisch significant effect heeft op de toename van kalvergewicht tot 13 weken na de start van de proef. Voederconversie in de eerste 12-19 dagen was niet verschillend tussen de groepen aangezien er geen effect was van de hoeveelheid kunstmelk op kalvergewicht. De voederconversie van het vaste voer in de laatste acht weken van de proef was niet verschillend tussen de algen en controlegroep. Algen kunnen dus toegevoegd worden aan het dieet van rosé vleeskalveren tot een inclusiepercentage van 2% van de kunstmelk droge stof zonder dat gewichtstoename of voederconversie van kunstmelk of vaste voeders beïnvloed worden. Er werd geen significant effect (P=0.055) op kalvergezondheid (gevallen van diarree en van ‘niet drinken’) gevonden, maar de resultaten bieden perspectief voor verder onderzoek naar het effect van algen in kalvervoeders op kalvergezondheid. Dit zal moeten plaatsvinden onder geoptimaliseerde proefcondities, aangezien gedurende de huidige proef enkele verbeterpunten genoteerd werden.

Introduction

This trial was performed as part of the SNN project “Naar een nieuwe verwaarding van algenbiomassa” (In English: “Towards a new valorization of algal biomass”), project number T2014. The general goal of the project is to research and identify applications of algal biomass, based on biorefinery. This field trial was performed to determine the effects of feeding algae on health, growth and feed conversion of rose veal calves (pinkables) aged 2 to 13 weeks. In case a positive effect can be shown, a possible next step is to refine the algae and determine whether the effect is still present in one fraction, while another fraction can be used for further valorization.

1 Field trial setup

1.1 General

Farm selection, instruction of the farm owners, and general monitoring were done by Iewe Hofstede (Rumiadd, the Netherlands). The algae used in this trial were provided by Douwe Zijlstra (Kelstein, the Netherlands). Calf feed was provided by Peter Overeem (P. Bos veevoeders, the Netherlands). The farm owners collected the data, which were statistically analyzed and reported at ACRRES by the authors of this report.

The field trial took place at the veal farm of Mr. and Mrs. Smelt in Vriezenveen (the Netherlands) from 1 July to 2 October 2015. The calves originated from different dairy farms in the region. They arrived at different dates, between 1 and 8 July 2015. The start dates of the trial are therefore variable. The total group consisting of 55 calves was divided in an 'algae' group (30 animals) and a control group (25 animals). The trial was divided into two feeding periods. During Period 1 (from start date until 20 July 2015, 12-19 days) the calves were mainly fed individually rationed amounts of dissolved milk powder (with or without addition of algae), while hay was available ad libitum. During Period 2 (from 20 July 2015 until 2 October 2015, 74 days) no algae were added and the animals were fed group-wise using decreasing daily amounts of dissolved milk powder and increasing daily amounts of solid feeds. During the trial the following parameters were monitored: calf weight, amounts of formula milk, water, solid feeds, feed additions and medication, deviations in manure structure, and disease incidence. Individual calf weights were determined at arrival on 1 July to 8 July 2015 (first weighing), on 4 August 2015 (second weighing), at the end of formula milk feeding (on 21 August 2015, third weighing), on 10 September 2015 (fourth weighing), and on 2 October (fifth weighing).

1.2 Housing

The calves were housed in one stable divided into 15 pens (Figure 1).

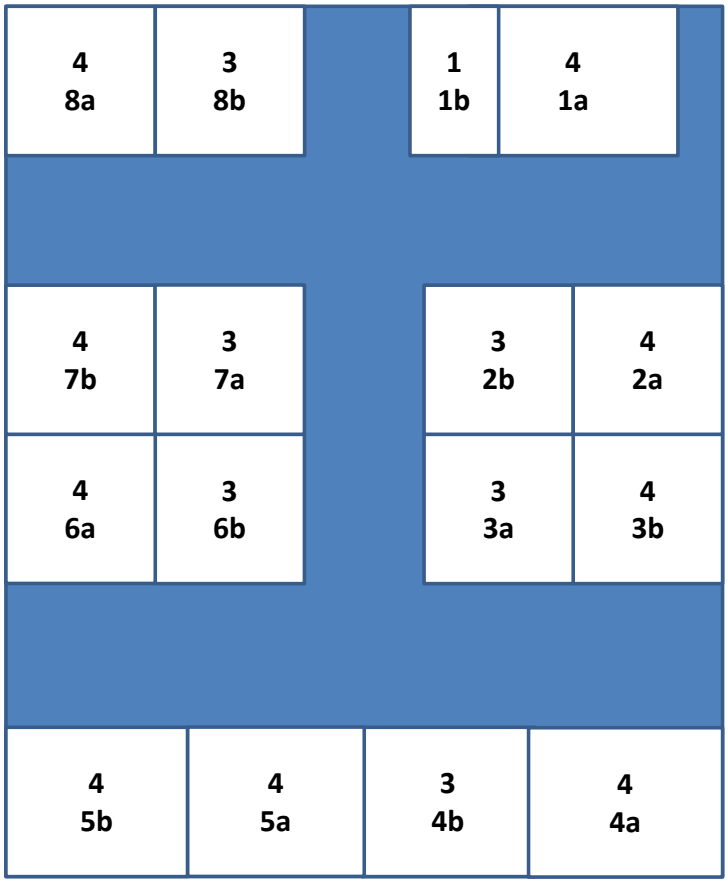

Figure 1 Schematic plan of the stable with calves. Abbreviations used: # = number of calves in each pen. 1a-8a and 1b-8b are the pen numbers for the algae and control group respectively

In each pen 3 or 4 calves were housed, except for in pen 1b, where one calf was housed individually (Table 1). The influence of indoor climate was minimized by alternating 'control' and 'algae' pens. During Period 1 the calves were housed individually within the pens by means of iron bars. At the start of Period 2 the bars were removed and calves could freely move and feed within their pen. Calves with similar feed consumption were at that point grouped together in pens within the algae and the control group. This meant that the initial distribution of individual animals over the pens was adjusted, while maintaining the alternation between 'control' and 'algae' pens.

Table 1 Initial distribution of the calves for each pen with calf codes and start dates.

Algae group (n=30)	Calf codes	Start date	Control group (n=25)	Calf codes	Start date
1a	2804	6/7/2015	1b	9256	2/7/2015
	2805				
	2806				
	2807				
2a	4628	6/7/2015	2b	8568	1/7/2015
	5170			1907	
	4424			3806	
	3285				
3a	4425	6/7/2015	3b	2389	6/7/2015
	0624			0310	
	8279			6752	
				6628	
4a	4612	6/7/2015	4b	3761	6/7/2015
	5613			4569	
	2179			4421	
	2096				
5a	4422	8/7/2015	5b	6273	8/7/2015
	9868			4568	
	2097			9783	
	9781			5598	
6a	6715	3/7/2015	6b	8569	1/7/2015
	6716			0493	
	0309			1908	
	6629				
7a	6718	3/7/2015	7b	2095	1/7/2015
	6714			5025	
	6717			5487	
				5488	
8a	7698	6/7/2015	8b	6111	1/7/2015
	8572			4343	
	7621			9784	
	4423				

1.3 Algae addition

The calves were fed according to a standard schedule of formula milk and solid feed, with the exception that algae calves were given algae as an addition to their milk. The algae originated from an open pond. Prior to the trial, fresh algae were harvested by centrifugation to a paste of approximately 15 % dry weight, which was then frozen and stored at -20 °C. Appendix I shows species composition and nutritional values of the algae. To each dry weight kg of milk powder, 133 to 135 g wet algae paste (thawed overnight) was added, resulting in an addition of approximately 20 g dry weight algae for each kg of milk powder, i.e. 2 %. In total, the algae group was fed 0.5 kg of dry weight algae per calf until the third weighing date (21 August 2015).

1.4 Solid feed and feed additions

During Period 1, both groups were given both hay and water ad libitum, in addition to formula milk (with or without algae) and calf feed pellets in the last six days of Period 1. Calves were fed individually. Furthermore, both groups were administered sodium salicylate and Farm-O-San Startfit, a vitamin/mineral mix. Vitakoe (Vossen Agriculture, the Netherlands) was administered multiple times to the control group and only occasionally to the algae group. In addition, the control group was given Bio A (Vossen Agriculture, the Netherlands). Feed amounts were daily registered for every calf.

During Period 2, calves could feed freely within pens, but not between pens. In this period they were fed decreasing amounts of formula milk (with or without algae addition) until the third weighing moment. They were fed increasing amounts of solid feeds (hay, straw, silage, corn, feed pellets and meal). The different types of feeds were mixed and the mixture was weighed and divided over the pens. Feed amounts and feed leftovers were registered daily for each group. Feed additions/medicine during this period were sodium salicylate, doxycyclin, bromhexine and Startfit.

Depending on symptoms, individual calves were given the following medications: Novem, Norfenicol, Buscopan, Vecoxan, vitamin B, colostrum or Bio Colon. Bio Even was nebulized in the stable on two days.

Further information on applied medications and additions is supplied in Appendix II.

1.5 Statistical analysis

The data from the trial were statistically analysed using Genstat Release 18.0 (PC/Windows 7). The trial consisted of eight blocks and two pens per block (Figure 1). The number of animals per pen was 1, 3 or 4. The two treatment levels were randomized over the two pens within each block. Analysis of variance was performed on measured response variables such as weight and growth rate. The averages per treatment level and the probability of the F-test is presented. The response per animal was displayed in a Trellis plots as function of starting day.

The effects of start calf weight, start dates and the amount of milk powder consumed during Period 1 on the weights and treatment differences were tested using covariance analysis and the repeated measures facilities of Genstat.

2 Results

No differences in feeding behavior, for example as a result of taste differences, were observed between the two groups.

2.1 Weight

Appendix III shows the individual weight results. In Figures 2 and 3 the averages for the individual calf weights and individual calf weight increases for each group are shown.

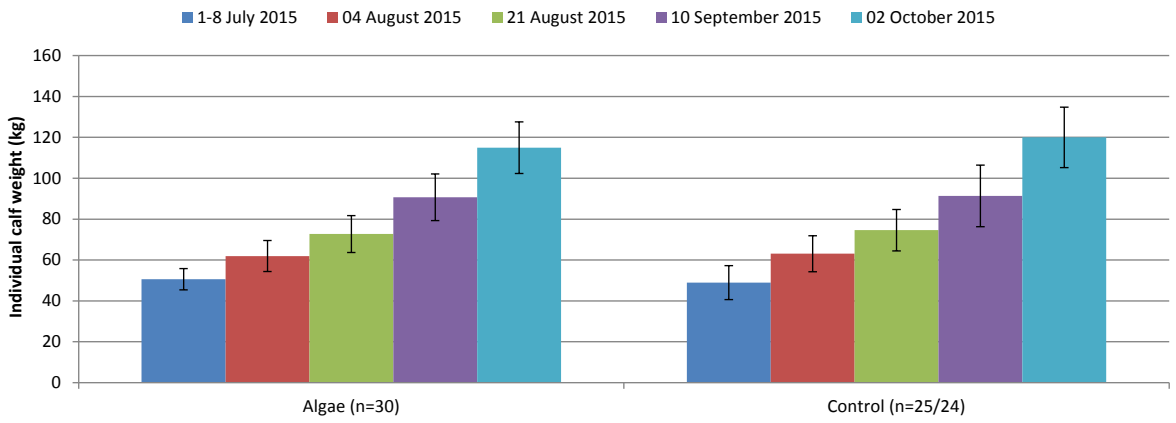

Figure 2 Average individual calf weights for the algae and the control group. Error bars represent standard deviation**.** In the control group, one calf died before the fifth weighing, therefore the group size was 24 instead of 25 for this period.

In 2012 the average daily weight increase in general for rose veal calves was 1107 and 1136 g per day for 280 and 220 day old calves, respectively, according to Wageningen UR Livestock Research (2012). The average daily weight increase in the current trial was 742 g per day over the whole period. This difference can be explained by the age difference, as the average weight increase during the last weeks of period 2 (9 September to 2 October) was 1134 g per calf per day, which is similar to the reference values mentioned above. Statistical analysis of the data shown in Figure 2 are displayed in Table 2.

Table 2 Average weights (kg) from analysis of variance per treatment and four dates. Abbreviations used: n.s. = not significant, LSD = least significant difference, F pr. = F probability

Object	Start Weight	Weight 4-8	Weight 21-8	Weight 10-9	Weight 2-10
Algae	48.99	61.84	72.74	90.92	115.1
Control	50.59	63.19	74.57	91.09	119.6
LSD	3.106	4.687	5.664	8.388	7.304
F pr.	n.s.	n.s.	n.s.	n.s.	n.s.

The least significant difference (LSD) is the smallest difference between two treatment means that is significant according to the t-test at probability 0.05. Per date there were no significant differences between the treatments according to the F-test (n.s.). The start weight per calf was on average 48.99 kg for the algae group and 50.59 kg for the control group (Table 2). However, the minimum and maximum start weight within the algae group was 39 kg and 57 kg respectively and the minimum and maximum start weight within the control group was 38 kg and 74 kg respectively (Appendix III). This shows there were big differences in start weight between the animals within each group. At the later weighing days 4 August, 21 August, 10 September and 2 October the animals with high start weight within both groups, often still have a high weight within their group (Appendix IV, Figure A). However, a correction for the start weight using covariance analysis did not change the fact that there were no significant weight differences between the groups on 4 August, 21 August, 10 September and 2 October in Table 2.

There was no influence of start date (Table 1) on the weights of the calves on 4 August, 21 August, 10 September and 2 October according to the used covariance analysis. So the start dates had no influence on the differences in weight between the algae and the control group.

There was no effect of the amount of supplied dissolved milk powder from start of the trial until 20 July (Appendix V) on calf weight on 4 August, 21 August, 10 September, and 2 October using covariance analysis. This means that differences between the algae and the control group were not influenced by the amount of milk powder supplied.

Figure 3 shows the average individual calf weight increase in between the weighings.

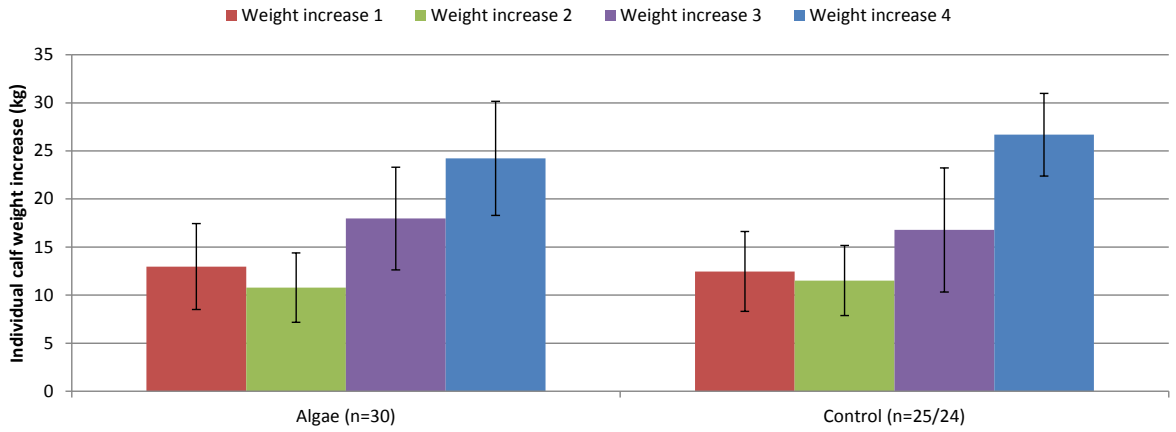

Figure 3 Average individual calf weight increases for the algae and the control group in four consecutive periods. Error bars represent standard deviation. In the control group, one calf died before the fourth weighing, therefore the group size was 24 instead of 25 for this period. Weighing dates were 1-8 July 2015, 4 August 2015, 21 August 2015, 10 September 2015 and 2 October 2015.

Statistical analysis of the data shown in Figure 3 are displayed in Table 3.

Table 3 Average growth from analysis of variance per treatment and four periods. Abbreviations used: n.s. = not significant, LSD = least significant difference, F pr. = F probability

Object	Growth 1	Growth 2	Growth 3	Growth 4
Algae	12.85	10.90	18.18	24.24
Control	12.60	11.38	16.52	26.71
LSD	2.631	1.971	4.287	2.736
F pr.	n.s.	n.s.	n.s.	<0.10

Per period 1, 2, and 3 there were no significant differences between the treatments according to the F-test (n.s.). The difference between the treatments in period 4 was just above the significance level because calf 0493 was still present at 10 September but was absent on 2 October.

Next to start weight, start date could have had an influence on the calf weights. For the animals per pen the starting date was the same. The starting date varies from 1 to 8 July and differs between the pens. Table 4 shows the number of animals per group for the different start dates.

Table 4 Number of animals added to the trial per day in July and per treatment group

Date	Algae	Control	Total
1 July	0	13	13
2 July	0	1	1
3 July	5	0	5
6 July	21	7	28
8 July	4	4	8
Total	**30**	**25**	**55**

In Appendix IV Figure B the weight per calf as function of days from start of the trial is shown.

2.2 Formula milk

In Period 1, the calves were housed individually and the amount of formula milk per calf per day was noted (Table 5). For Period 2, only the total amount of formula milk per group per day is known and standard deviations could not be calculated.

Table 5 Average total amount of formula milk (kg) per calf in the different periods (with standard deviation if applicable) for each group

Period	Algae group	Control group
Period 1	7.9 (0.7)	8.7 (1.4)
Period 2 until 3rd weighing	14.6	14.3
Total	22.5	22.9

The total amount of dry matter fed to the calves is almost equal for both groups when the algae addition of 0.5 kg dry matter per calf is taken into account for the algae group.

2.3 Solid feed consumption and feed conversion ratio

Calves were fed different types of solid feed, starting in the last six days of Period 1. During these days they were offered in total 0.75 kg of calf feed pellets per calf. During Period 2 they were fed several solid feeds in a mixture (Table 6). In Appendix VI the daily feeding amounts are shown.

Table 6 Average total amount of solid feeds during Period 2 (in kg per calf in 74 days).

Feed	Algae group	Control group
Total feed mixture provided per calf	288.6	320.9
Total remaining feed mixture per calf	20.9	24.4
Total feed mixture eaten per calf	267.9	296.6*
Silage	1.0	1.3
Hay	3.3	3.9

*The death of one of the calves in the control group was not taken into account

The percentages of feed consumed were 93% for the control group and 92% for the algae group. The remaining feed was discarded. The control group has consumed more feed than the algae group (296.6 kg versus 267.9 kg per calf).

As there is no statistically significant difference in end weight or weight gain between the two groups (Tables 2 & 3), a comparison of feed conversion ratio (4.9 and 5.0 kg solid feed per kg weight gain between 5 August and 2 October, for the algae and control group, respectively) which uses only the average end weight and not the spread in results, is probably not very meaningful. That said, it seems that the control group displayed a higher feed intake, which did not result in a significantly higher end weight or weight gain. It might be tempting to state that the algae group achieved a similar end weight as the control group, while consuming less feed. However, the reason why the control group was fed more than the algae group is unknown, and the trial set up was not focussed primarily on feed conversion, but on end weight and weight gain.

2.4 Additions/medication

During Period 1 the calves were given Vitakoe, Bio A, Sodium salicylate and Startfit (Table 7).

Table 7 Feed additions as total number of dosages per calf for Period 1 per pen

Pen #	Vitakoe	Bio A	Sodium salicylate	Startfit
1a	1	0	10	3
2a	2	0	9	3
3a	2	0	9	3
4a	2	0	9	3
5a	2	0	7	3
6a	2	0	9	3
7a	2	0	9	3
8a	0	0	11	3
1b	10	2	7	2
2b	13	4	9	3
3b	13	4	9	3
4b	13	4	9	3
5b	13	4	7	3
6b	13	4	9	3
7b	14	4	9	3
8b	13	4	9	3

During Period 2 the following feed additions were given (Table 8):

Table 8 Feed additions as total number of dosages per calf for Period 2 per group

Addition	Algae group	Control group
Vitakoe	0	17
Sodium salicylate	9	9
Doxycyclin	9	9
StartFit	5	5
Bromhexine	5	5

During Period 1, only the control group received Bio A, while this group also received many more Vitakoe dosages than the algae group. During Period 2, Vitakoe dosages were administered exclusively to animals in the control group. The reason for the extra supply of feed additives to the control group is unknown, but it does introduce difficulties in the interpretation of the trial results. As there was no group that received neither the extra additives nor the algae, it may only be said that Bio A and Vitakoe have a similar effect on the calves as did the algae addition, but the effect can be positive, negative, or neutral.

2.5 Deviations in manure structure

In Table 9 deviations in manure structure are shown, as observed by the farm owners.

Table 9 Overview of deviations in manure structure (1=milk manure, 2=clay manure, 3= diarrhea thin as water, 4=diarrhea thin/ dung cake like, 5= rumen acidification)

Group	Pen #	Calf #	Manure structure	Date
Algae	1a	2805	3	1/7, 7/7
Algae	2a	3285	3	7/7, 8/7
Algae	5a	4422	3	9/7
Algae	6a	6629	1	11/7
Algae	7a	6718	3	12/7, 24/7
Algae	8a	4423	1	7/7
Control	1b	9256	1	12/7
Control	2b	1907	1	7/7
Control	3b	6628	3	7/7, 9/7
Control	3b	0310	3	9/7
Control	4b	4421	1	9/7
Control	5b	4568	3	15/7
Control	6b	0493	1	2/7, 4/7, 5/7
Control	6b	1908	1	7/7
Control	7b	5025	3	3/7
Control	7b	5488	1	8/7
Control	8b	4343	4	5/7, 10/7

Only 20 %, or 6 animals out of 30, from the algae group and 44 %, or 11 animals out of 25, from the control group suffered from diarrhea. The P-value of the Pearson X^2 test was 0.055 (just above 0.05), which means the difference between algae and control group was not significant. Considering feeding algae to animals, Spruijt et al (2014) describe several studies on positive effects of algae on animal health. Cho and Yoon (2014) give an overview of diagnostic methods for the detection of several pathogens involved in calf diarrhea. Possible effects of algae (or algae fractions after refinery) may be quantified with these methods in future investigations.

2.6 Disease incidence

Disease incidence was recorded (Table 10), but data are not taken into account, since it was unknown what was the cause of the disease and whether the calf was already ill on arrival.

Table 10 Disease incidences and medication

Calf #	Pen #	Disease	Medication	Group	Date
4425	3a	Infection right fore-leg		Algae	Start?
9868	5a	Maggots on arrival	Novem, Norfenicol, Vit B	Algae	Start
9781	5a	Colic	Buscopan, lijnzaad, Vita Koe, Bio A	Algae	16/7
6715	6a	Infection right hind-heel/knee	Novem	Algae	Start? 11/7, 15/7
6714	7a	Belly pains	Buscopan	Algae	3/8
6717	7a	Lung problems	Norfenicol, Novem	Algae	5/8
7621	8a	Ear infection	Novem	Algae	23/7
9256	1b	Fever	Novem, Norfenicol	Control	12/7
1907	2b	Navel rupture		Control	Start?
3761	4b	Does not drink	Novem, Norfenicol	Control	7/7
4568	5b	Does not drink	Novem	Control	8/7
5598	5b	Diarrhea (3) on arrival, does not drink, possibly colic	Novem, Buscopan, colostrum	Control	Start, 9/7, 10/7
8569	6b	Does not drink	Novem	Control	1/7
5025	7b	Does not drink	Novem, Vecoxan	Control	1/7

In both groups, seven incidences of disease were observed. It is unknown whether disease incidence was related to the health of the calves at the start of the trial or to the conditions during the trial. The number of calves not drinking at a certain time during the trial was higher for the control group (four incidences in the control group as opposed to zero incidences in the algae group). Calf 0493 died at 28 September 2015 after continuous weight loss due to unknown causes.

3 Remarks on trial operation

During the execution of this trial, some points for improvement can be noticed. These in no way diminish the commitment of Mr and Mrs Smelt in taking care of their animals, but as these matters may have influenced the trial, and to secure transparency of the results, a list follows below:

- It seems that the control group was formed with calves that arrived first at the farm, and the algae group with animals arriving later and at somewhat differing dates.
- Feeding regime prior to the trial was variable and is unknown
- Start dates of the trial are variable, and as a result the amount of days they were fed with formula milk with or without algae
- Composition of the algae is not exactly known (species and nutritional values) as well as date of harvesting
- The trial was not blind, and the same persons who did the feeding also recorded health related data.
- Except for Period 1, it is not known what the feed intake for each individual calf was, since they could feed freely within each pen on formula milk and solid feed
- During Period 1 the calves could freely eat hay
- After Period 1 the calves were grouped according to feed intake within the control or algae group. Even though they were moved within the two groups, it is not known what pen they were moved to.
- For unknown reasons, the control group received more feed additives than the algae group. To study the possible effect of algae addition to feed, other feed additives should have been given to neither, or to both groups.

4 Conclusions

The main conclusion of this field trial is that the addition of algae to the formula milk of rose veal calves during a period of 44 to 51 days did not have a statistically significant effect on calf weight increase up to 13 weeks after the start of the trial. When taking into account the effects of start weight, milk powder consumed, or start date, this result did not change. The control group was administered much more dosages of natural (mineral) mixtures for supporting health and growth. In the group that was fed algae less incidences of diarrhea and 'not drinking' seemed to be observed, but the difference was not statistically significant. Feed conversion in Period 1 was not different between groups as there was no effect of formula milk amount on calf weight. Solid feed conversion in the last eight weeks of the trial was not different for algae and control group. Algae can be added to the diet of veal calves at an inclusion percentage of 2% of the formula milk dry matter without affecting weight increase or feed conversion of formula milk or solid feeds. Regarding interpretation of the above conclusions, care should be taken for reasons mentioned in the 'Remarks on trial operation' section. There was no significant effect on calf health (P=0.055), but the results justify further research on the effect of algae addition to calf feeds on calf health under optimized trial conditions.

5 Acknowledgments

The authors thank Marjanne and Bert Smelt (Maatschap Smelt), Fam. Zijlstra (Kelstein), Iewe Hofstede (Rumiadd), Arthur Kroon (AF&F), Peter Overeem (P. Bos veevoeders), Ed van Benthem (van Benthem), Klaas Zijlstra (Asqa subsidies), Menno Sorgedrager (CLEA) and Maarten Meijer (Tendris) for their contributions to this field trial and report and Durk Durksz (WUR, Animal Sciences Group) for his comments on this report.

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7 Appendix I Algae composition

Overview of species composition and nutritional values of the algae* (Kroon, 2015).

Algae used in this trial are a mix of species. The composition varies during the year but nutrient dosing and mixing regime result in green algae being the dominant group (cyanobacteria and diatoms constitute less than 1% of the total biomass). Dominant species are *Scenedesmus* spp., *Ankistrodesmus* spp., *Chlorella* spp. and *Pediastrum* spp. According to season, their share in the total biomass varies: in autumn *Pediastrum* spp. is dominant, while in spring *Chlorella* spp. and *Scenedesmus* spp. are seemingly dominant.

Several analyses were performed on the algae:

- Total fat and fatty acids (4/2011)
- Amino acids (10/2012)
- Moisture, ash, protein, fibre, lipid (after hydrolysis), K, Na, Ca, Mg, P, Mn, Fe, Zn, Cu, Co, Mo, Cr, S, Se, As, Cd, Ni, Pb, Hg (4/2011)
- *Salmonella* (7/2014)
- C total, N total (5/2014)
- As, Cd, Pb, Hg (5/2014)

**Data are indicative only, as samples were analysed over an extended period prior to the current trial.*

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LEUVEN

Vetzuurprofiel zongedroogde en gevriesdroogde algenmix van Algae Food & Fuel

Stalen: zongedroogd AF&F mix, gevriesdroogd AF&F mix
Datum en wijze ontvangst: opgestuurd door klant
Datum analyses: 13.04.2011
Datum verslag: 31.05.2011
Gevraagde analyses: vetzuurprofiel totale lipiden

Gebruikte methodes

Het *totaal lipidengehalte* (uitgedrukt als g / 100 g droge alg) wordt gravimetrisch bepaald na extractie met chloroform / methanol (1:1) De voorbehandeling bestaat uit een sonicatie. De resultaten zijn het gemiddelde van twee herhalingen.

Het *vetzuurprofiel van de totale lipiden* (uitgedrukt als % van totale hoeveelheid vetzuren) wordt bepaald door de geëxtraheerde totale lipidenfractie te veresteren tot methylesters en deze gaschromatografisch te scheiden. Er wordt gebruik gemaakt van een vlamionisatiedetector. Identificatie van de pieken geschiedt door vergelijking met een standaardmengsel FAMEs. De resultaten zijn het gemiddelde van het vetzuurprofiel van de twee extracten.

Resultaten

De resultaten van het totaal lipidengehalte zijn weergegeven in onderstaande tabel.

Staal	Totaal lipidengehalte (g / 100 g droge alg)
AF&F zongedroogd	11.9 ± 5.0
AF&F gevriesdroogd	16.2 ± 1.2

Prof. dr. ir. Imogen Foubert
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De resultaten van de bepaling van het vetzuurprofiel van de totale lipidenfractie (uitgedrukt als % op totale hoeveelheid vetzuren) zijn weergegeven in onderstaande tabel. Van de met de momenteel beschikbare standaarden niet te identificeren pieken werd telkens aangegeven waar ze zich in het chromatogram bevinden en werd tussen haakjes ook een indicatie gegeven over welk vetzuur het mogelijk gaat.

Vetzuur	AF&F zongedroogd	AF&F gevriesdroogd
C14:0	n.d.	0.6 ± 0.07
C14:1	1.1 ± 0.00	0.6 ± 0.07
Niet geïdentificeerd tussen C14:1 en C15:0	n.d.	1.6 ± 0.07
C15:0	3.1 ± 0.07	0.3 ± 0.00
C16:0	28.6 ± 0.99	13.1 ± 0.21
C16:1 (9cis)	6.1 ± 0.35	6.5 ± 0.49
Niet geïdentificeerd tussen C16:1 en C18:0 (meervoudig onverzadigde C16)	13.7 ± 0.14	24.8 ± 0.28
C18:0	2.6 ± 0.00	n.d.
C18:1 (9cis)	15.5 ± 1.41	6.1 ± 0.07
C18:2 (9cis, 12cis)	3.9 ± 0.07	5.9 ± 0.00
C18:3n-3	11.7 ± 0.35	33.1 ± 0.21
Niet geïdentificeerd tussen C18:3n-3 en C20:1 (meervoudig onverzadigde C18)	1.2 ± 0.07	3.4 ± 0.00
C20:1	8.3 ± 0.57	0.4 ± 0.21
C20:5n-3	n.d.	0.6 ± 0.14
C22:0	1.9 ± 0.21	0.4 ± 0.07
C22:2	0.5 ± 0.00	0.2 ± 0.00
C22:4	0.3 ± 0.00	n.d.
C22:5	0.5 ± 0.07	0.2 ± 0.00
C22:6n-3	n.d.	0.3 ± 0.00
C24:0	1.4 ± 0.78	n.d.
C24:1	1.6 ± 0.07	n.d.

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ANALYSERAPPORT

PROVIMI B.V. - LABORATORIUM

Benthem B.V., Van
Postbus 2
8325 ZG VOLLENHOVE

Klantnummer	1041
Datum ontvangst	24-10-2012
Datum gereed	08-11-2012
Datum rapportage	08-11-2012
Opdrachtgever	Benthem B.V., van

Monster nummer **240639**

Monsterinformatie:

Datum monstername	- -		
Monster verpakking	Plastic zak	Conditie ontvangen :	Ongeopend
Omschrijving	Lelystad mengsample		
Opmerkingen	julisep 2012,stoofdroof,brokken		

Onderzoeksresultaten:	Methode:	Resultaat:	
Cysteine	HPLC	5.3 g/kg	U
Methionine	HPLC	7.4 g/kg	U
Asparginezuur	HPLC	38.2 g/kg	U
Threonine	HPLC	18.7 g/kg	U
Serine	HPLC	17.0 g/kg	U
Glutaminezuur	HPLC	41.2 g/kg	U
Glycine	HPLC	24.0 g/kg	U
Alanine	HPLC	28.1 g/kg	U
Valine	HPLC	22.5 g/kg	U
iso-Leucine	HPLC	15.1 g/kg	U
Leucine	HPLC	30.1 g/kg	U
Phenylalanine	HPLC	18.2 g/kg	U

U = Uitbesteed

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Rabobank Nederland, Utrecht account no. 30.00.28.598, IBAN NL39 RABO 0300 0285 98, Swift: RABONL2U
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Datum ontvangst	24-10-2012
Datum gereed	08-11-2012
Datum rapportage	08-11-2012
Opdrachtgever	Benthem B.V., van

Monster nummer **240639**

Onderzoeksresultaten:	Methode:	Resultaat:	
Histidine	HPLC	6.9 g/kg	U
Lysine	HPLC	20.9 g/kg	U
Arginine	HPLC	17.9 g/kg	U
Tryptophan		5.42 g/kg	U

U = Uitbesteed

Provimi B.V. - laboratorium
ing. A.G.G. van Waveren
Laboratory Manager

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Datum ontvangst	24-10-2012
Datum gereed	08-11-2012
Datum rapportage	08-11-2012
Opdrachtgever	Benthem B.V., van

Monster nummer **240640**

Monsterinformatie:

Datum monstername	- -		
Monster verpakking	Plastic zak	Conditie ontvangen :	Ongeopend
Omschrijving	hallum batch no 1;10		
Opmerkingen	HAv123 th,stoofdroog gemalen		

Onderzoeksresultaten:	Methode:	Resultaat:	
Cysteine	HPLC	3.2 g/kg	U
Methionine	HPLC	6.0 g/kg	U
Asparginezuur	HPLC	25.3 g/kg	U
Threonine	HPLC	13.0 g/kg	U
Serine	HPLC	11.1 g/kg	U
Glutaminezuur	HPLC	27.8 g/kg	U
Glycine	HPLC	18.1 g/kg	U
Alanine	HPLC	23.8 g/kg	U
Valine	HPLC	15.9 g/kg	U
iso-Leucine	HPLC	10.8 g/kg	U
Leucine	HPLC	22.4 g/kg	U
Phenylalanine	HPLC	13.3 g/kg	U

U = Uitbesteed

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Datum gereed	08-11-2012
Datum rapportage	08-11-2012
Opdrachtgever	Benthem B.V., van

Monster nummer **240640**

Onderzoeksresultaten:	Methode:	Resultaat:	
Histidine	HPLC	5.0 g/kg	U
Lysine	HPLC	12.2 g/kg	U
Arginine	HPLC	13.3 g/kg	U
Tryptophan		4.32 g/kg	U

U = Uitbesteed

Provimi B.V. - laboratorium
ing. A.G.G. van Waveren
Laboratory Manager

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Rel.nr. 895
Kelstein Produktie B.V.
Kelnersweg 8
9074 LJ Hallum

Laboratoriumnr.: **332679**

ANALYSEVERSLAG DIVERSE PRODUKTEN

Monstergegevens:

Produkt: algen
Partij: 4. algenoogst - V2 - (5 april '11)

Datum monstername: -
Vorm monstername: Derden

Datum ontvangst: 06-04-11

Analyseresultaten (bepaald):

Parameter	Resultaat	Eenheid	Methode
Vocht	**65.4**	%	AV V As Znd
Ruw As	**657**	g/kg droge stof	AV V As Znd
Ruw Eiwit	**149**	g/kg droge stof	AV Rec Ntc
Ruwe Celstof	**60**	g/kg droge stof	AV RC
Vet (na hydrolyse)	**19**	g/kg droge stof	AV Vet
Kalium	**5.7**	g/kg droge stof	AV Mineralen
Natrium	**14.8**	g/kg droge stof	AV Mineralen
Calcium	**19.6**	g/kg droge stof	AV Mineralen
Magnesium	**2.6**	g/kg droge stof	AV Mineralen
Fosfor	**24.0**	g/kg droge stof	AV Mineralen
Mangaan	**316**	mg/kg droge stof	AV Mineralen
IJzer	**2684**	mg/kg droge stof	AV Mineralen
Zink	**3582**	mg/kg droge stof	AV Mineralen
Koper	**17.7**	mg/kg droge stof	AV Sporen
Cobalt	**4.3**	mg/kg droge stof	AV Sporen
Molybdeen	**0.03**	mg/kg droge stof	AV Sporen
Chroom	**16**	mg/kg droge stof	AV Sporen
Zwavel	**3.2**	g/kg droge stof	AV Sporen
Selenium	**1.15**	mg/kg droge stof	AV Sporen
Arseen	**< 3.0**	mg/kg droge stof	AV UBS
Cadmium	**0.24**	mg/kg droge stof	AV UBS
Nikkel	**25**	mg/kg droge stof	AV UBS
Lood	**35**	mg/kg droge stof	AV UBS
Kwik	**< 0.10**	mg/kg droge stof	AV UBS

nutrilab

Analyserapport

Order-nr : 397708

Koch Bodemtechniek

Postbus 21
7400 AA DEVENTER

Omschrijving	:	140713702 FIR EINDPRODUCT PARTIJ 17			
Ontvangstdatum	:	10-07-2014	Monsternamedatum	:	07-07-2014
Rapportdatum	:	14-07-2014	Inzetdatum microbiologie	:	10-07-2014
Monsternemer	:		Monstertransport	:	Post/Koerier
Verpakking	:	Plastic zakje	Monstertemperatuur	:	Kamertemperatuur
Verzegeld	:	N	Monsterconditie	:	Monster en verpakking intact

Bepaling			Resultaat	
Microbiologisch onderzoek				
I 785	Salmonella, PCR (gelijkwaardig aan ISO 6579)	a	niet aangetoond	/25 g

Startdatum analyse: 10-07-2014, einddatum: 12-07-2014.
a) Dit resultaat is indicatief. De tijd tussen bemonsteren en inzetten van deze analyse is langer dan maximaal toegestaan of niet bekend. Hierdoor is het analyseresultaat mogelijk niet representatief voor de microbiologische samenstelling van het monster op het moment van monstername.

Operationeel manager : ing. A. J. Voorberg - Nederlof

info@nutrilab.nl
www.nutrilab.nl
KvK 18114291
BTW NL002097654B01

De betekenis van de gebruikte tekens is:

Q Analyse met RvA-accreditatie (ISO/IEC 17025)
I Analyse door Nutrilab BV uitgevoerd
E Analyse door Nutrilab BV uitbesteed

Scientific Analysis Laboratories Ltd

Certificate of Analysis

Hadfield House
Hadfield Street
Cornbrook
Manchester
M16 9FE
Tel : 0161 874 2400
Fax : 0161 874 2468

Report Number: 392679-2

Date of Report: 08-May-2014

Customer: Koch - Eurolab
Keulenstraat 19a
DEVENTER
THE NETHERLANDS
7418 ET

Customer Contact: Mr Carl Koch

Customer Job Reference:
Date Job Received at SAL: 01-May-2014
Date Analysis Started: 05-May-2014
Date Analysis Completed: 08-May-2014

The results reported relate to samples received in the laboratory
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with SAL SOPs
All results have been reviewed in accordance with QP22

Report checked
and authorised by :
Annie Hennis
Project Manager

Issued by :
Annie Hennis
Project Manager

SAL Reference: 392679
Customer Reference:

Bulk Product(animal feed) Analysed as Bulk Product(animal feed)
Miscellaneous

	SAL Reference	392679 001
	Customer Sample Reference	140412528 Mineral feed batch / partij 17

Determinand	Method	Test Sample	LOD	Units	
Cr (Total)	T301	AR	0.1	mg/kg	**35.1**
Ni (Total)	T301	AR	0.5	mg/kg	**17**

SAL Reference: 392679
Customer Reference:

Bulk Product(animal feed) Analysed as Bulk Product(animal feed)
Bulk Product Suite 2

	SAL Reference	392679 001
	Customer Sample Reference	140412528 Mineral feed batch / partij 17

Determinand	Method	Test Sample	LOD	Units	
As (Total)	T301	AR	0.2	mg/kg	**3.9**
Cd (Total)	T301	AR	0.01	mg/kg	**0.36**
Pb (Total)	T301	AR	0.03	mg/kg	**5.6**
Hg (Total)	T301	AR	0.01	mg/kg	**0.09**

Index to symbols used in 392679-2

Value	Description
AR	As Received
N	Analysis is not UKAS accredited

Method Index

Value	Description
T301	ICP/MS (Total)

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Cr (Total)	T301	AR	0.1	mg/kg	N	001
Ni (Total)	T301	AR	0.5	mg/kg	N	001
As (Total)	T301	AR	0.2	mg/kg	N	001
Cd (Total)	T301	AR	0.01	mg/kg	N	001
Pb (Total)	T301	AR	0.03	mg/kg	N	001
Hg (Total)	T301	AR	0.01	mg/kg	N	001

8 Appendix II Medications and additions

Description, usage, and effect of applied medications during the trial, as claimed by the manufacturers.

Bio A (Vossen Agriculture) is a liquid natural product to support the respiratory system. It is based on organic acids, and herbal and fruit extracts.

Bio Colon (Vossen Laboratories) is dosed to the milk and based on herbs and plants. It supports intestinal health.

Bio Even (Vossen Agriculture) is used for air cleaning in stables and is based on organic acids and herbs.

Bromhexin is used to treat respiratory problems

Buscopan is used for the treatment of diarrhea

Doxycyclin is an antibiotic used to treat bacterial infections

Norfenicol is an antibiotic for the treatment of respiratory tract infections.

Novem is used for treatment of inflammations, fever, and pain

Sodium salicylate is used to treat respiratory infections and inflammations.

StartFit (Farm-O-San) is a supplemental animal feed (vitamins/minerals) that is added to the milk to support the natural defence system.

Vecoxan is used to prevent and treat intestinal problems (coccidiosis).

Vita Koe (Vita Cow, Vossen Agriculture) is a premix on the basis of acids, fruit and herb extracts used to improve the palatability of silage and stimulate the functioning of the digestive system. It also supports the condition of liver and kidneys, optimising blood cleansing and waste separation, and so condition and resistance as a whole.

9 Appendix III Weighing data

Weighing data of 55 calves (kg).

Group	Pen	Calf	Start date	Start weight	4/8	21/8	10/9	2/10	Growth 1	Growth 2	Growth 3	Growth 4
Algae	1a	2804	6-jul-15	53.5	72.0	86.5	99.0	128.5	18.5	14.5	12.5	29.5
Algae	1a	2805	6-jul-15	42.0	57.5	64.0	75.5	98.0	15.5	6.5	11.5	22.5
Algae	1a	2806	6-jul-15	52.5	63.5	75.5	89.5	114.5	11.0	12.0	14.0	25.0
Algae	1a	2807	6-jul-15	47.5	56.5	63.0	80.5	103.5	9.0	6.5	17.5	23.0
Algae	2a	4628	6-jul-15	47.5	60.0	73.5	85.0	112.5	12.5	13.5	11.5	27.5
Algae	2a	5170	6-jul-15	57.0	70.5	82.0	97.0	125.0	13.5	11.5	15.0	28.0
Algae	2a	4424	6-jul-15	40.0	55.5	66.5	82.5	108.0	15.5	11.0	16.0	25.5
Algae	2a	3285	6-jul-15	54.5	66.5	87.0	105.5	103.5	12.0	20.5	18.5	-2.0
Algae	3a	4425	6-jul-15	43.0	59.5	75.5	88.5	111.5	16.5	16.0	13.0	23.0
Algae	3a	624	6-jul-15	49.5	68.5	83.0	107.0	136.0	19.0	14.5	24.0	29.0
Algae	3a	8279	6-jul-15	53.5	65.5	78.0	101.5	130.5	12.0	12.5	23.5	29.0
Algae	4a	4612	6-jul-15	54.0	67.0	79.0	103.0	125.0	13.0	12.0	24.0	22.0
Algae	4a	5613	6-jul-15	52.0	65.0	73.5	98.0	127.0	13.0	8.5	24.5	29.0
Algae	4a	2179	6-jul-15	51.5	66.5	78.5	104.0	128.0	15.0	12.0	25.5	24.0
Algae	4a	2096	6-jul-15	48.5	61.5	73.0	97.0	124.0	13.0	11.5	24.0	27.0
Algae	5a	4422	8-jul-15	51.0	60.5	74.0	97.0	117.0	9.5	13.5	23.0	20.0
Algae	5a	9868	8-jul-15	47.0	48.0	52.5	70.0	87.0	1.0	4.5	17.5	17.0
Algae	5a	2097	8-jul-15	48.0	61.5	67.0	85.5	104.0	13.5	5.5	18.5	18.5
Algae	5a	9781	8-jul-15	44.0	54.0	62.0	67.5	97.0	10.0	8.0	5.5	29.5
Algae	6a	6715	3-jul-15	42.5	61.5	74.5	96.0	119.0	19.0	13.0	21.5	23.0
Algae	6a	6716	3-jul-15	56.0	79.0	82.0	90.0	118.0	23.0	3.0	8.0	28.0
Algae	6a	309	6-jul-15	44.5	55.5	67.0	88.5	114.0	11.0	11.5	21.5	25.5
Algae	6a	6629	6-jul-15	39.0	49.0	58.0	75.5	97.0	10.0	9.0	17.5	21.5
Algae	7a	6718	3-jul-15	40.5	44.0	52.5	68.0	93.5	3.5	8.5	15.5	25.5
Algae	7a	6714	3-jul-15	45.5	57.0	69.0	83.5	108.0	11.5	12.0	14.5	24.5
Algae	7a	6717	3-jul-15	51.0	63.0	73.5	93.0	119.5	12.0	10.5	19.5	26.5
Algae	8a	7698	6-jul-15	54.0	66.5	78.0	98.0	123.0	12.5	11.5	20.0	25.0
Algae	8a	8572	6-jul-15	50.0	66.5	77.0	101.0	127.5	16.5	10.5	24.0	26.5
Algae	8a	7621	6-jul-15	54.5	72.5	80.0	104.0	129.0	18.0	7.5	24.0	25.0
Algae	8a	4423	6-jul-15	55.0	64.0	76.0	89.5	118.5	9.0	12.0	13.5	29.0
Control	1b	9256	2-jul-15	41.0	56.5	67.5	81.0	103.5	15.5	11.0	13.5	22.5
Control	2b	8568	1-jul-15	53.5	62.0	78.5	102.0	127.0	8.5	16.5	23.5	25.0
Control	2b	1907	1-jul-15	46.5	58.5	69.5	86.0	113.5	12.0	11.0	16.5	27.5
Control	2b	3806	1-jul-15	42.0	57.0	66.0	84.5	110.5	15.0	9.0	18.5	26.0
Control	3b	2389	6-jul-15	44.0	61.0	76.5	95.5	127.0	17.0	15.5	19.0	31.5
Control	3b	310	6-jul-15	50.5	56.5	70.0	86.0	114.0	6.0	13.5	16.0	28.0
Control	3b	6752	6-jul-15	63.0	79.5	100.5	121.5	157.0	16.5	21.0	21.0	35.5
Control	3b	6628	6-jul-15	43.5	53.0	62.5	73.5	95.0	9.5	9.5	11.0	21.5
Control	4b	3761	6-jul-15	65.0	80.0	90.0	111.0	145.0	15.0	10.0	21.0	34.0
Control	4b	4569	6-jul-15	46.0	60.5	70.5	88.0	115.5	14.5	10.0	17.5	27.5
Control	4b	4421	6-jul-15	52.0	66.5	77.0	97.0	128.0	14.5	10.5	20.0	31.0
Control	5b	6273	8-jul-15	49.5	61.5	76.0	91.0	118.5	12.0	14.5	15.0	27.5
Control	5b	4568	8-jul-15	52.0	65.0	74.0	97.5	118.0	13.0	9.0	23.5	20.5
Control	5b	9783	8-jul-15	48.5	61.0	74.0	93.0	123.0	12.5	13.0	19.0	30.0
Control	5b	5598	8-jul-15	54.5	64.5	79.0	101.0	127.0	10.0	14.5	22.0	26.0
Control	6b	8569	1-jul-15	51.0	62.5	73.5	89.5	120.0	11.5	11.0	16.0	30.5
Control	6b	493	1-jul-15	38.0	47.0	53.5	45.0	*	9.0	6.5	-8.5	*
Control	6b	1908	1-jul-15	46.5	59.0	72.0	86.0	110.5	12.5	13.0	14.0	24.5
Control	7b	2095	1-jul-15	44.0	57.5	71.5	93.0	118.0	13.5	14.0	21.5	25.0

Control	7b	5025	1-jul-15	64.0	66.0	77.5	89.5	108.5	2.0	11.5	12.0	19.0
Control	7b	5487	1-jul-15	48.0	66.5	70.5	88.5	111.0	18.5	4.0	18.0	22.5
Control	7b	5488	1-jul-15	49.5	64.5	79.0	101.5	127.5	15.0	14.5	22.5	26.0
Control	8b	6111	1-jul-15	52.5	57.0	67.0	79.0	99.5	4.5	10.0	12.0	20.5
Control	8b	4343	1-jul-15	74.0	89.0	98.5	119.5	149.5	15.0	9.5	21.0	30.0
Control	8b	9784	1-jul-15	46.5	65.0	70.5	84.5	113.0	18.5	5.5	14.0	28.5

*Calf 0493 died on 28 September

10 Appendix IV Statistical analysis

Within the control group there are four animals with a high start weight (Figure A). Three of these animals have high weights also on 4 August, 21 August, 10 September and 2 October. One animal (calf #0493) from the control group had a low weight on 10 September. This animal died on 28 September, several days before the weighing on 2 October. The correlation coefficient, R, in Figure A, is measure of the closeness of the linear relationship between the animal weights on the five dates, and may vary from -1 to 1. For R = -1 all points are exactly on a falling line, for R = 0, there is no linear relationship, and for R = 1 the points are exactly on a rising line. The correlation between start weight and the weight on the four consecutive dates is 0.85, 0.81, 0.72, and 0.67, respectively. So, it can be concluded that animals with high weights at the start of the trial still have high weights at the end of the trial.

Figure A Scatter diagrams of the animal weights at four time points

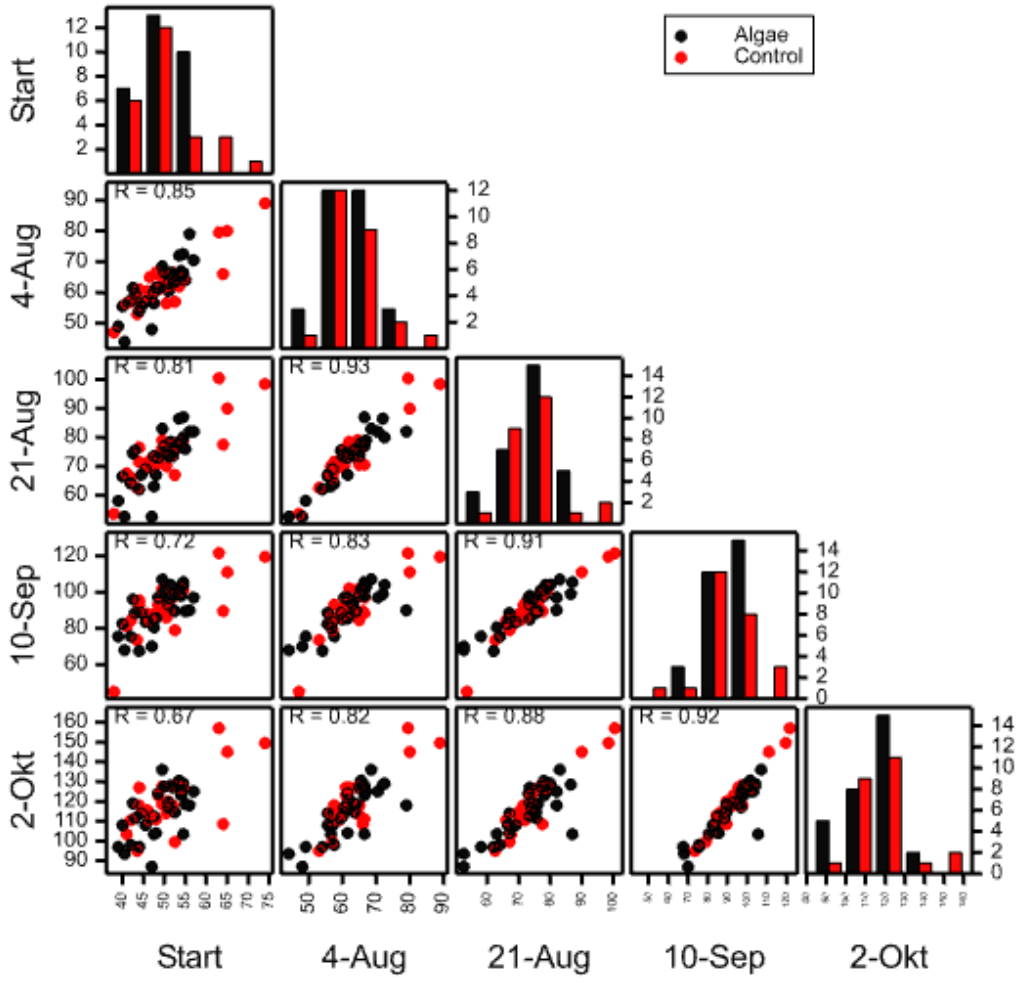
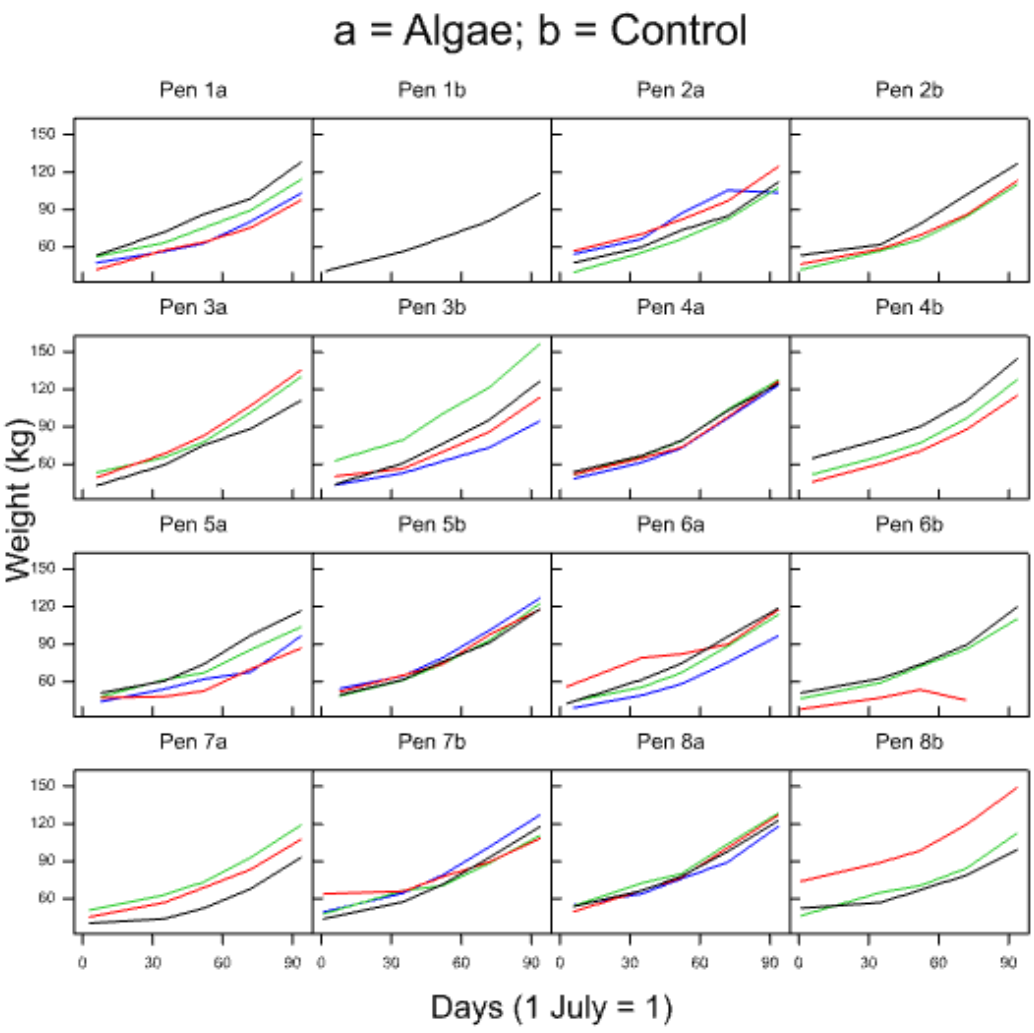


Figure B Weight per calf as function of days from start of the trial, five time points and 1 = 1 July 2015



11 Appendix V Milk powder per calf until 20 July 2015

Pen #	Calf #	Milk powder (g)
1a	2804	7780
	2805	7780
	2806	7780
	2807	7780
2a	4628	7780
	5170	7780
	4424	7780
	3285	7780
3a	4425	7680
	624	7680
	8279	7680
4a	4612	7780
	5613	7780
	2179	7780
	2096	7780
5a	4422	6520
	9868	6520
	2097	6520
	9781	6520
6a	6715	8767
	6716	8767
	309	8767
	6629	8767
7a	6718	9029
	6714	9029
	6717	9029
8a	7698	7795
	8572	7795
	7621	7795
	4423	7795
1b	9256	8768
2b	8568	10026
	1907	10026
	3806	10026
3b	2389	7780
	310	7780
	6752	7780
	6628	7780
4b	3761	7530
	4569	7530
	4421	7530
5b	6273	6520
	4568	6520
	9783	6520
	5598	6520
6b	8569	10026
	493	10026
	1908	10026
7b	2095	9406
	5025	9406
	5487	9406
	5488	9406
8b	6111	10026
	4343	10026
	9784	10026

12 Appendix VI Solid feeds

Solid feeds during Period 2 (kg). Provided = total feed mixture provided to each group per day. Rest = total feed mixture left over for each group per day. Corn, hay, feed pellets and meal are the daily amounts of feed components added to the mixture in total for both groups. Misc = other feeds provided to each group.

Date	Provided algae	Rest algae	Provided control	Rest control	Corn	Hay	Pellets	Meal	Misc algae	Misc control
20-7	20	12.5	11	6.5	23	4	4			
21-7	9.5	4	8	2.5	9.5	4	4			
22-7	15		11		18	4	4		Hay 17	Hay 29
23-7	1 kg pellets	7	1 kg pellets	5			1			
24-7	21.5	7.5	21.5	3.5	35	4	4		Hay 19	
25-7	14	0	13.5		19.5	4	5			
26-7	17	9	13	4	21	4	5			
27-7	21	5.5	17.5	3.5	27.5	3	6	2	Hay 21.5	Hay 13
28-7	25	3	29.5	10.5	43.5	3	6	2		
29-7	23	0	27.5		38.5	3	7	2		
30-7	33		28.1		48	2	7	4		Hay 23
31-7	28	9.5	23.5	10	37.5	2	8	4		
1-8	26		30		44	0	8	4		
2-8	31		35.5		53.5	0	7	6		Hay 15
3-8	29	11	24	12.5	39	0	6	8		
4-8	32		28		45	0	5	10	Hay 19	
5-8	35.5	5	35	5.5	50.5	0 Straw	4	16		Hay 18.5
6-8	47.5		39		63.5	3	4	16		
7-8	49	10	41	12.5	59	9	6	16	Hay 21.5	
8-8	55.5	23.5	52	41.5	76.5	7	8	16		
9-8	60		56		75.5	5.5	8	20		
10-8	66	13	64	24.5	79	5.5	4	28		
11-8	69.5		61		81.5	8.5	4	36		
12-8	71		60		82	8.5	2	38		
13-8	85		71.5		93	8.5	0	56	Silage 9	Silage 9
14-8	83.5	15	85	20.5	100	8.5	0	60		
15-8	119	40	110	41.5	140.5	8.5	0	80		
16-8	105		97		114	9	0	80	Silage 7	Silage 7
17-8	140	57	117	45.5	150	9	0	86	Silage 5	Silage 8
18-8	121		110		126	9	0	96	Silage 6	Silage 6
19-8	122	55	121	43.5	138	9	0	96		
20-8	120		113		120	9	0	104	Silage 2.5	Silage 3.5
21-8	151.5		121		151.5	9	0	112		
22-8	122		135.5		136.5	9	0	112		
23-8	108.5	23.5	125	18	112.5	9	0	112		
24-8	117.5	53	134	46	98.5	9	32	104		
25-8	137.5	13.5	132	13.5	132.5	9	32	96		
26-8	114	30.5	124	18	101	9	32	96		
27-8	129	33	133	53	168	9	32	96		
28-8	155	67.5	150	82.5	168	9	32	96		
29-8	138.5		132.5	20	134	9	32	96		
30-8	156	17	142		161	9	32	96		
31-8	137.5		114		134	5.5	32	96		
1-9	165.5		137.5		161.5	5.5	40	96		
2-9	139	21	126	10.5	113.5	5.5	40	96		

3-9	171	17.5	170	25	199.5	5.5	40	96		
4-9	178	28	160	14.5	196.5	5.5	40	96		
5-9	151		151		160.5	5.5	40	96		
6-9	147		143		148.5	5.5	40	96		
7-9	129		132		119.5	5.5	40	96		
8-9	113		120		91.5	5.5	40	96		
9-9	122		121		104.5	5.5	40	96		
10-9	183		146		187.5	5.5	40	96		
11-9	137.8		178.5		165	5.5	40	96		
12-9	199		167		224.5	5.5	40	96		
13-9	144		176		178.5	5.5	40	96		
14-9	164		139		159	4	70	70		
15-9	185		165		206	4	70	70		
16-9	185.5		158		199.5	4	70	70		
17-9	207		140		203	4	70	70		
18-9	192	35	197.5	17	245.5	4	70	70		
19-9	200.5		223		279.5	4	70	70		
20-9	193		144		193	4	70	70		
21-9	169		134		159	4	70	70		
22-9	208		222		286	4	70	70		
23-9	185		166		207	4	70	70		
24-9	228		179		263	4	70	70		
25-9	204.5		162		222.5	4	70	70		
26-9	203		190		249	4	70	70		
27-9	236		127.5		219.5	4	70	70		
28-9	215.5		236		307.5	4	70	70		
29-9	182		174		212	4	70	70		
30-9	206		191.5		253.5	4	70	70		
1-10	153		148		157	4	70	70		
Total for all calves	**8658**	**627**	**8022**	**611**					**128**	**132**
Total per calf	**289**	**21**	**321***	**24***					**4.3**	**5.3**

*As calf 0493 from the control group died on 28 September 2015 and was probably ill before that date, the average amount of feed consumed per calf in the control group may have been somewhat higher, assuming less feed consumption by the animal in question.

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