

Effect of dietary protein level on protein content and quality of Arctic charr (*Salvelinus alpinus*)

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Abstract

Dose response trials were conducted with iso-energetic diets with protein content ranging from 34,7% to 49,2% fed to Arctic charr ranging in weight from 0,07 grams to 1050 grams in six trials. Low protein content in the feed tended to result in reduced protein content of small fish but this effect is not detectable in fish over 10 g. At the end of the trial with the biggest fish growing from 400 grams to 1050 grams a sensory evaluation was undertaken in order to see if different dietary protein content had any effect on the organoleptic quality of the fish.

Introduction

As a part of an ongoing project to determine the optimal protein need for different size of Arctic charr the chemical content of the fish was investigated to see if the protein content in the diet would influence composition and quality of the fish produced.

Materials and methods

Diet
Six different extruded diets were formulated using capelin meal as protein source, fish oil as lipid source and whole wheat as carbohydrate source. All diets were added the same vitamin and mineral premix. The chemical composition of the different diets is presented in Table 1.

Table 1: Chemical composition of experimental diets

Diet nr	712	713	714	715	716	717
Chemical analyses:						
Dry matter %	93,6	93,0	93,3	93,7	94,1	94,1
In DM:						
Crude protein %	37,1	38,6	40,8	45,5	48,4	52,3
Lipid %	27,4	27,5	25,5	25,1	24,4	23,2
Ash %	8,2	8,1	8,4	9,0	9,5	10,4

Fish
Six different size groups of fish were fed with the diets shown in Table 1. Description of the groups is shown in Table 2.

Table 2: Design of the fish trials

Group	1	2	3	4	5	6
Growth period d	120	45	85	90	112	80
Average initial Weight g	0,07	5	30	90	230	450
Average final weight g	4	10	80	230	690	1050
Analyzed part*	W	W	W	W	F	F

*) W = Whole body; F = Fillet

Sampling and analysis

Crude protein is presented as “as is” in the sample of either whole fish (4–230 grams) or in fillet (690 and 1050 grams fish) due to difficulties in getting homogeneity in the samples of the bigger fish. The Crude protein is defined as Kjeldahl N * 6,25.

Sensory analyses were also conducted on the two biggest weight classes of the Arctic charr according to QDA method (quantitative descriptive analysis). Where defined sensory attributes were evaluated to describe appearance, taste, odour and texture by a panel of trained group (Hootman, 1992; Stone and Sidel, 1985).

Results and discussion

The protein content in the fish is shown in Tables 3 and 4.

Table 3: Effect of dietary protein content and fish size on protein content in whole Arctic charr.

CP in diet DM %	37,1	38,6	40,8	45,5	48,4	52,3	Average
Fish size grams							
4	13,3	12,9	13,3	13,4	14,2	14,1	13,6
10	14,3	14,7	14,8	14,9	14,7	15,4	14,8
80	16,1	16,0	16,2	16,2	16,3	16,3	16,2
230	16,2	15,0	15,8	15,9	15,6	15,8	15,7

Table 4: Effect of dietary protein content and fish size on protein content in fillets of Arctic charr.

CP in diet DM %	37,1	38,6	40,8	45,5	48,4	52,3	Average
Fish size grams							
690	17,6	17,7	17,6	17,7	18,1	17,9	17,8
1050	17,7	17,7	18,0	17,5	17,7	18,1	17,8

There is a significant ($p < 0,01$) effect of fish size on the protein content in the fish showing increased protein content in the bigger fish. There was a rather unexpected tendency to effect of dietary protein content on the protein content in whole fish in the smallest size groups of fish. No such effect was however seen when the fish exceeds 10 grams.

Results from the sensory analyses of 1050 grams Arctic charr are shown in Table 5.

Table 5: Mean values of sensory traits (Scale 1 – 100), for groups of fish getting different content of crude protein in the diet. Different letters indicate significant differences ($p < 0,05$)

CP in diet DM %	F35%	F36%	F38%	F43%	F46%	F49%	
Odour							
sweet / characteristic	49	43	51	55	44	49	
metallic	34	31	37	38	32	34	
fresh oil	29	28	32	28	28	31	
earthy / musty	24	24	18	22	20	17	
sour	4	6	3	5	4	4	
rancid	7	3	7	8	4	7	
off - odour	4	8	4	5	8	4	
Appearance							
colour (white/orange)	***	48 ^b	61 ^a	53	59 ^a	63 ^a	44 ^b
heterogeneous colour		36	39	40	33	39	34
yellow liquid		35	44	37	34	42	41
fat droplets in liquid		40	51	40	40	51	44
white precipitation	***	32 ^{cd}	57 ^a	41 ^{bc}	36 ^{bc}	51 ^{ab}	34 ^{bc}
Flavour							
sweet / characteristic		55	46	54	54	51	52
metallic		37	38	37	42	40	34
fresh oil		34	33	35	36	35	31
earthy / musty		19	18	17	19	19	18
sour		5	4	6	5	7	4
rancid		7	4	5	7	4	5
off - flavour		7	6	4	5	6	8
Texture							
softness	ns ($p = 0.05$)	60	52	62	60	48	62
juicy	***	61 ^a	46 ^b	64 ^a	63 ^a	43 ^b	60 ^a
tender		53	54	59	61	55	62
sticky		42	48	48	53	42	48

ns = marginal significance, *** $p < 0,001$

As a whole there was limited variation in the sensory traits measured. Only four traits showed significant difference between groups of fish but this variation did not correlate to the different dietary treatment between the groups.

Conclusion

- Protein content in Arctic charr was found to increase with size of the fish
- A tendency was found that low dietary protein reduced protein content in Arctic charr fry (up to 10 grams)
- The organoleptic quality of marked size Arctic charr was not affected by dietary protein content

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