Identifisering av ukjente vekst og helsefremmende komponenter. Kan hydroksyprolin være en kandidat?

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Fish is healthy

For humans

and for animals and fish.

Focus on water soluble nitrogen-compounds in marine raw material with potential health promoting effects.

RESEARCH STRATEGY
Fiskeriforskning Bergen

Why is fish healthy ?

Biotechnological down stream processes

Biological tests

Identify interesting fractions

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Fractionation by filtration

Tissue separation

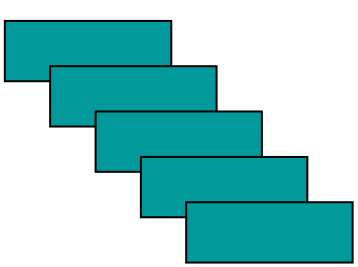
RESEARCH STRATEGY - Fiskeriforskning Bergen

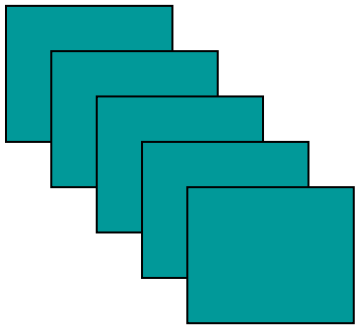
Why is fish healthy ?

Biotechnological down stream processes

Bones

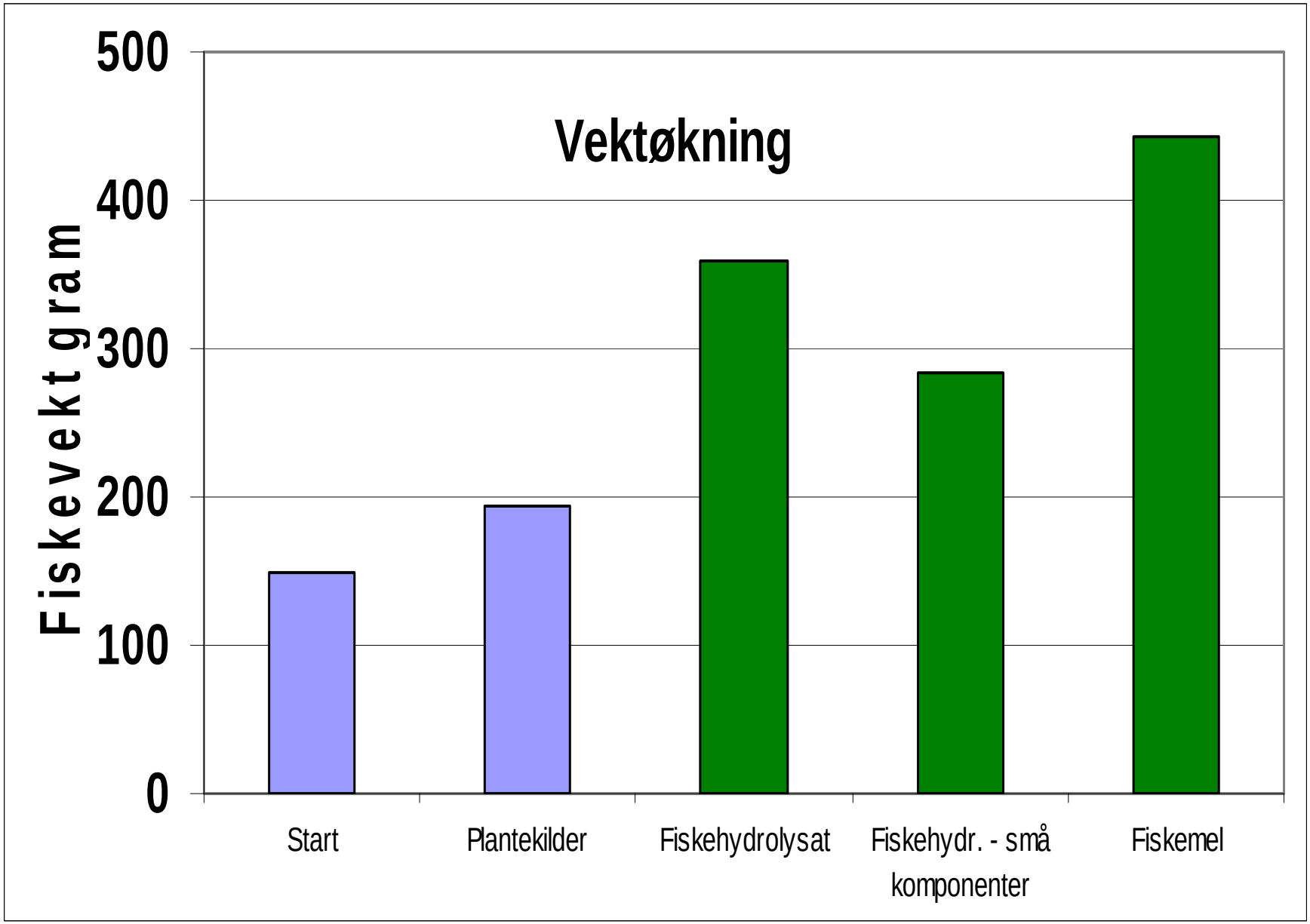
Muscle





Identify interesting fractions and compounds

Growth correlated to dietary ash


Vektøkning
Fiskevekt gram
500
400
300
200
100
0
Start
Plantekilder
Fiskehydrolysat
Fiskehydr. - små komponenter
Fiskemel

Trout exp.

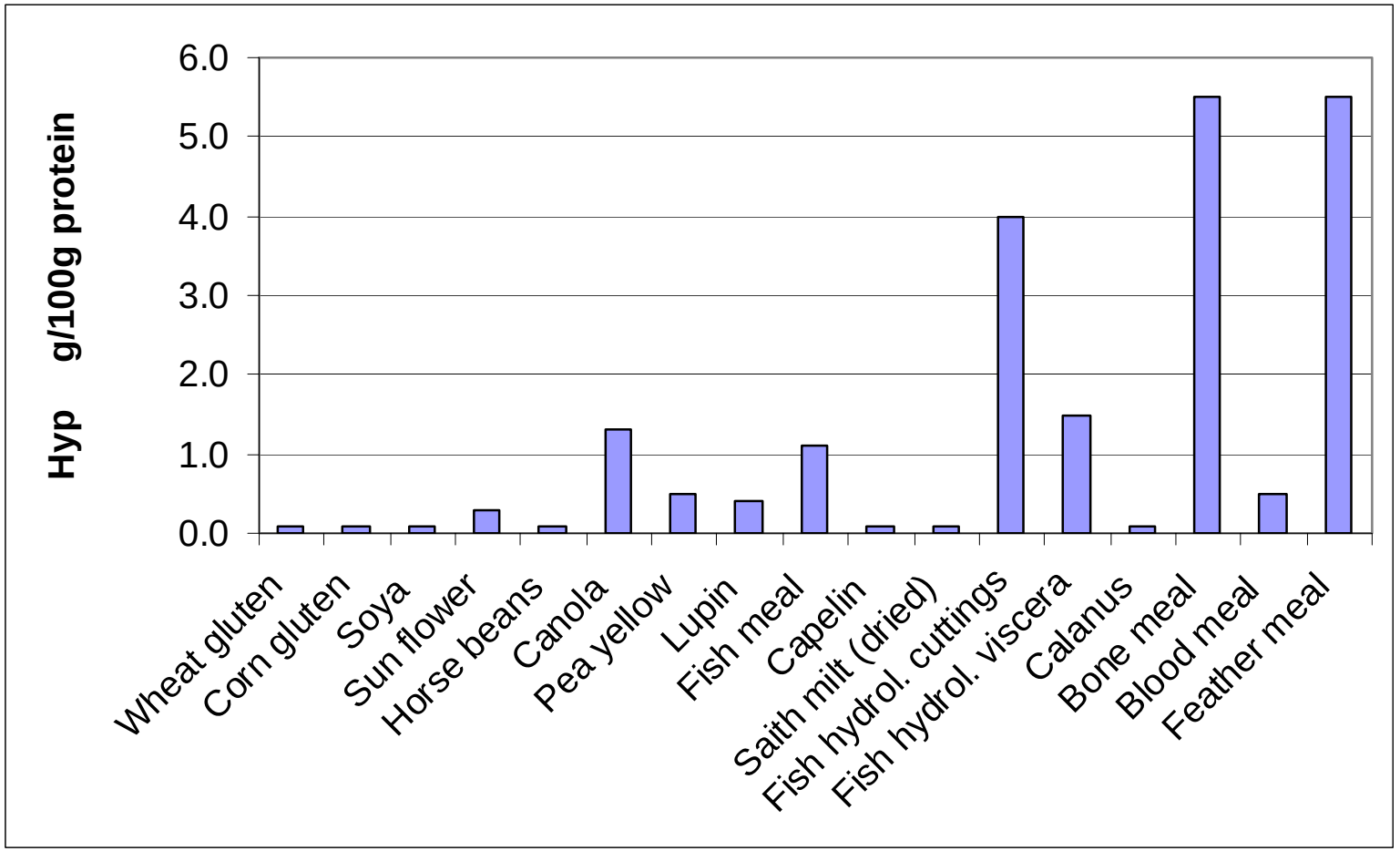
Varying inclusion of plant sources and fishmeal

Table 1
Dietary content of amino acids, taurine and anserine (g kg^{-1} crude protein)

	PP	LH	LR	HH	HR	FM
Dietary plant protein						
g kg^{-1}	353	288	291	223	232	223
% of total protein	90.6	73.9	74.9	57.2	59.4	57.0
Free amino acids (% of tot. prot.)	3.5	9.8	8.2	14.6	11.3	3.5
Taurine	0.8	2.8	2.3	4.3	2.8	3.3
Anserine	0.3	3.3	2.3	5.0	3.0	1.3
Aspartic acid	87	83	84	81	83	82
Glutamic acid	213	194	196	184	192	187
Hydroxyproline	2	8	8	12	14	5
Serine	53	49	50	48	49	50
Glycine	42	54	52	68	72	51
Histidine	24	23	23	22	22	22
Arginine	61	62	61	65	60	65
Threonine	36	35	34	35	34	37
Alanine	58	57	57	58	59	57
Proline	78	74	75	70	79	67
Tyrosine	43	32	32	31	33	37
Valine	48	43	43	41	41	47
Methionine	17	18	18	20	20	21
Isoleucine	45	40	39	37	37	43
Leucine	104	88	88	78	78	89
Phenylalanine	55	48	48	43	43	49
Lysine	52	62	56	62	58	51

Obs!!

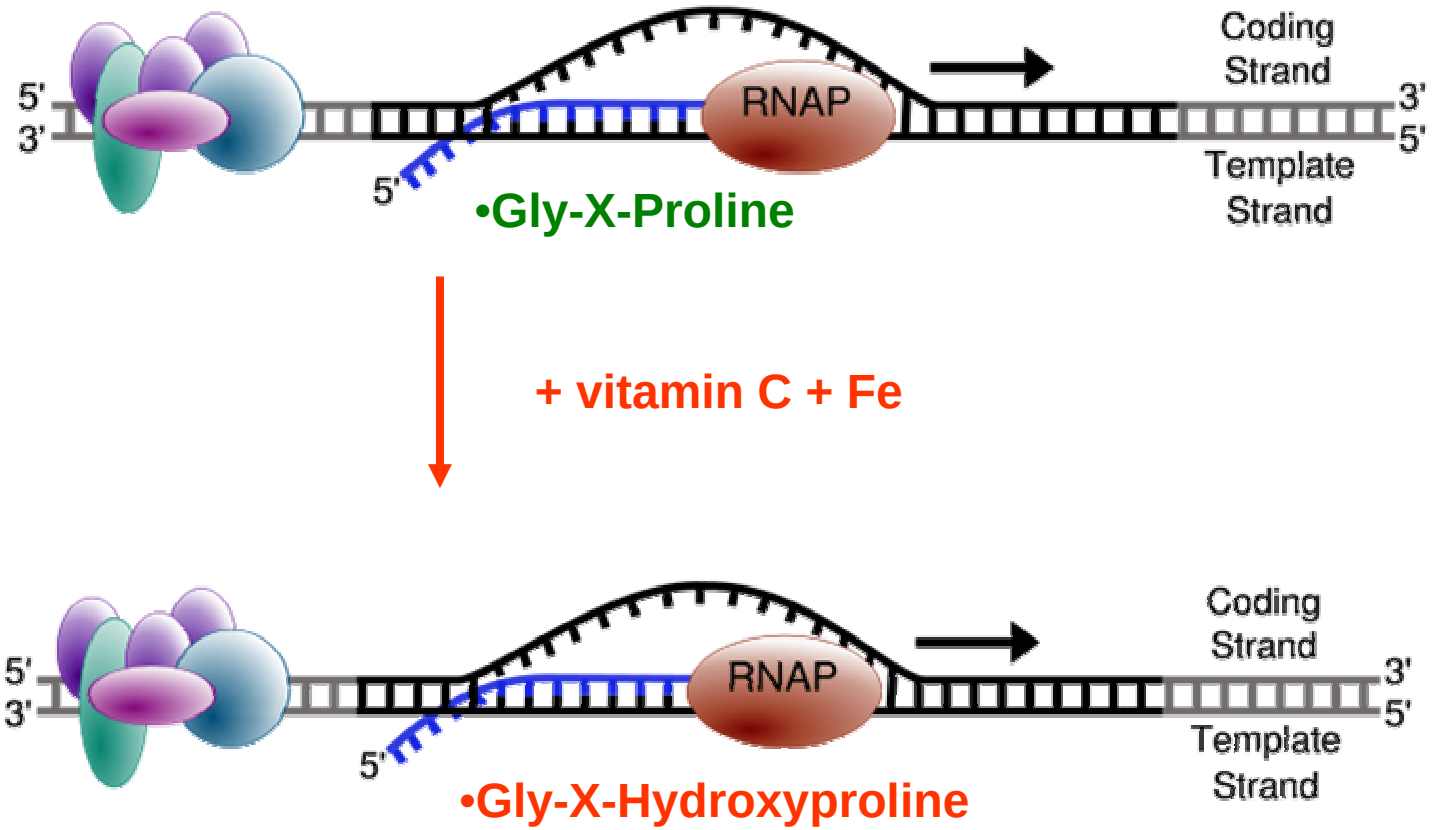
Hydroxyproline in feed ingredients



Essential amino acids in fish

Arginine	3.3 - 5.9	g/100 g protein
Histidine	1.3 - 2.1	g/100 g protein
Isoleucine	2.0 - 4.0	g/100 g protein
Leucine	2.8 - 5.3	g/100 g protein
Lysine	4.1 - 6.1	g/100 g protein
Methione	2.1 - 6.1	g/100 g protein
Phenylalanine	5.0 - 6.1	g/100 g protein
Threonine	2.0 - 4.0	g/100 g protein
Tryptophan	0.3 - 1.4	g/100 g protein
Valine	2.3 - 4.0	g/100 g protein

Formation of hydroxyproline



Amino acids in fish bones

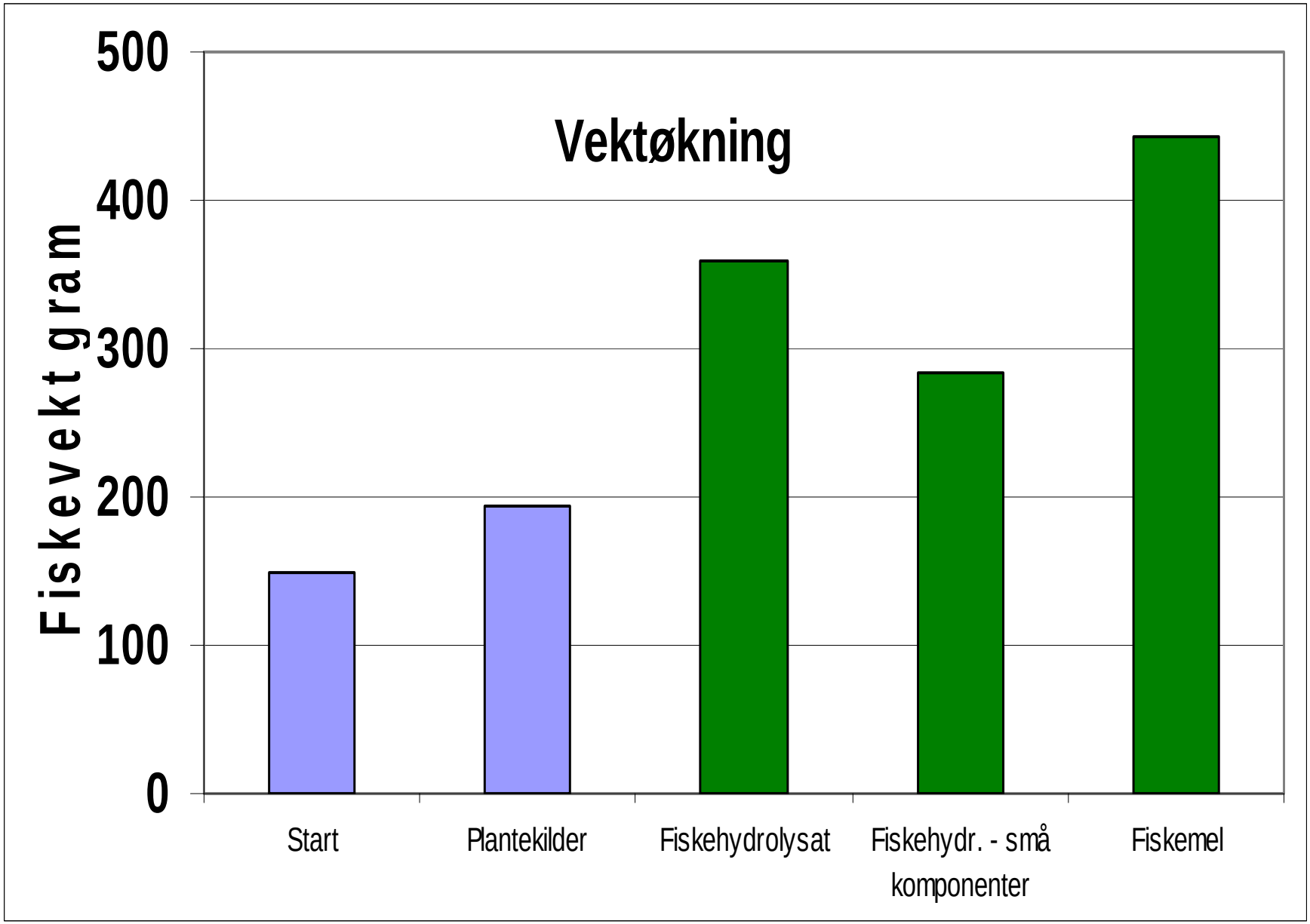
Table 4
Amino acids in fish bones in g/kg raw protein

	Cod	Saithe1	Blue whiting	Salmon1	Trout	Herring1 (small)	Herring2 (large)	Mackerel	Horse mackerel
Aspartic acid[a]	77	74	88	78	78	82	70	78	66
Glutamic acid[b]	112	110	126	112	112	115	103	110	103
Hydroxyproline	52	54	29	56	57	40	56	45	67
Serine	58	55	49	48	49	48	50	50	46
Glycine	172	175	115	173	173	134	177	138	191
Histidine	18	18	19	22	22	19	16	24	16
Arginine	82	82	77	78	78	77	77	81	81
Threonine	33	36	39	32	32	36	35	35	34
Alanine	73	74	68	73	71	69	79	70	87
Proline	80	86	63	86	82	72	91	73	103
Tyrosine	20	22	31	19	18	27	17	23	15
Valine	31	31	41	30	29	40	34	36	29
Methionine	24	23	30	26	26	29	25	24	22
Isoleucine	22	22	33	22	22	27	20	27	20
Leucine	43	40	59	41	39	52	44	51	40
Phenylalanine	25	26	35	26	26	34	29	31	26
Lysine	42	41	61	44	43	50	44	52	43
Cysteine/cystine	20	17	12	14	12	12	55	13	72
Tryptophan	4	4	8	4	4	7	6	6	5
Total amino acids	988	990	983	984	973	970	1028	967	1066

All data are based on replicates ($n=2$), general analytical deviation from mean <3.5%.

[a] Represents the sum of aspartic acid and asparagine.

[b] Represents the sum of glutamic acid and glutamine.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500
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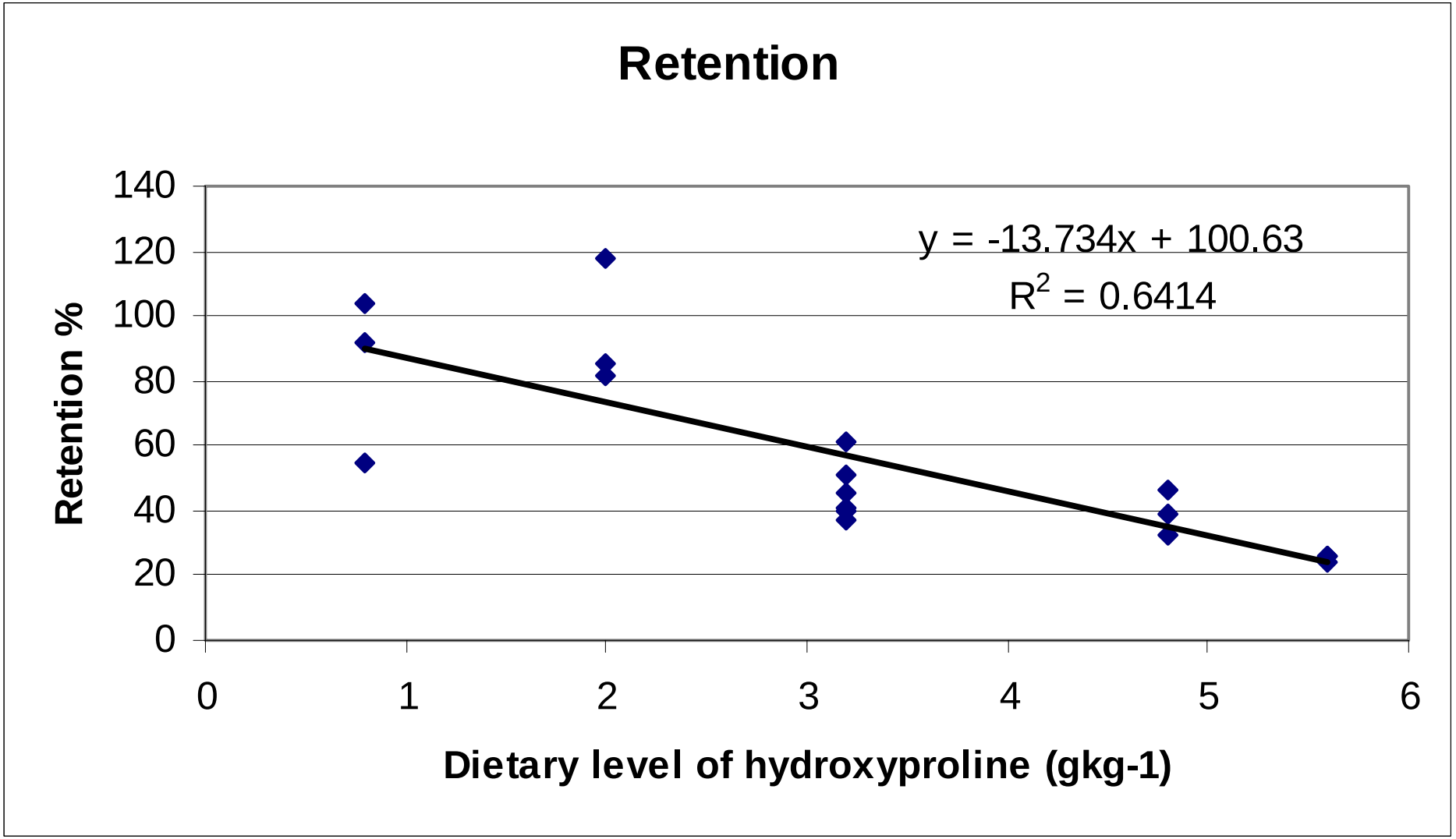
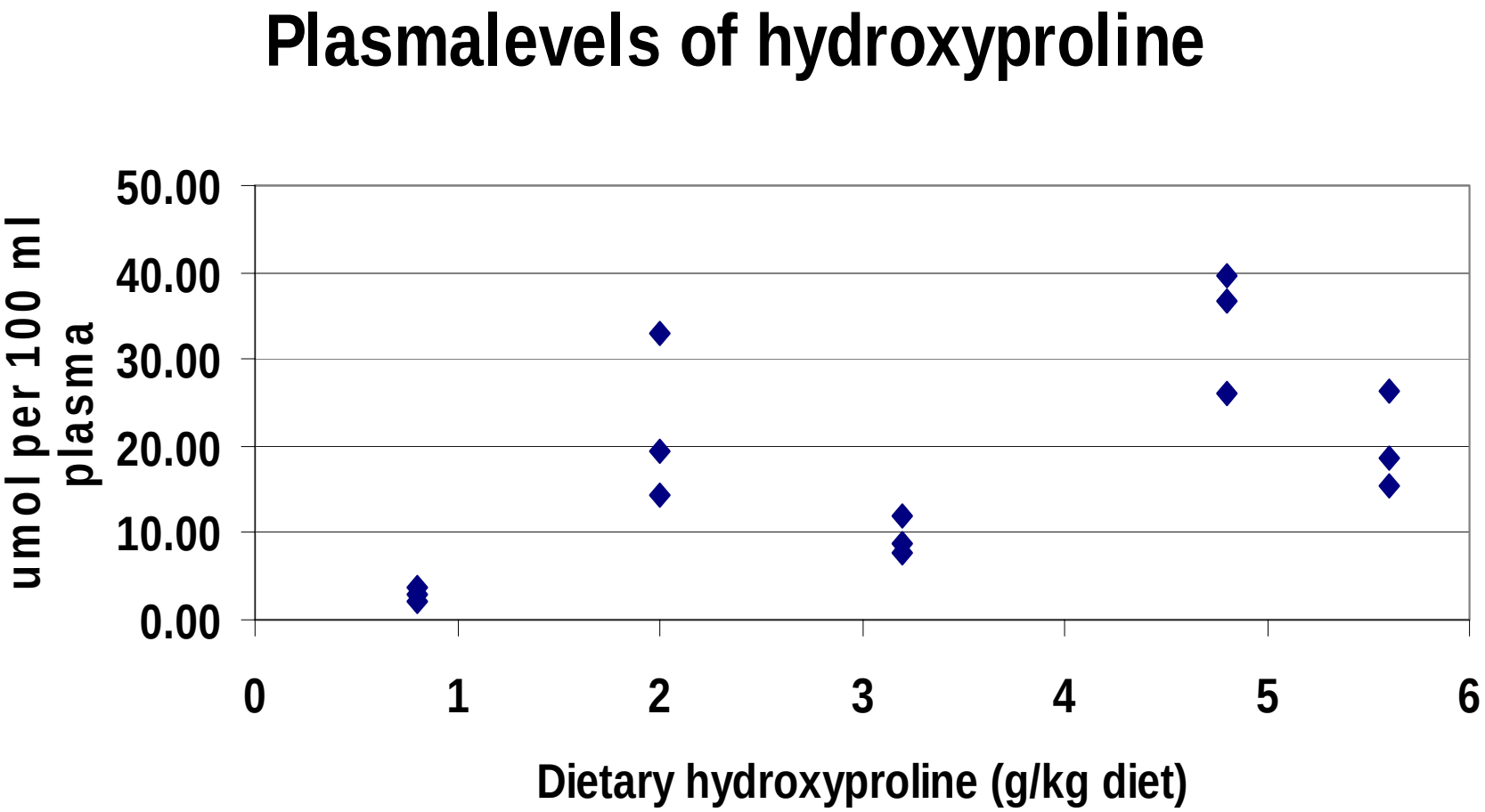
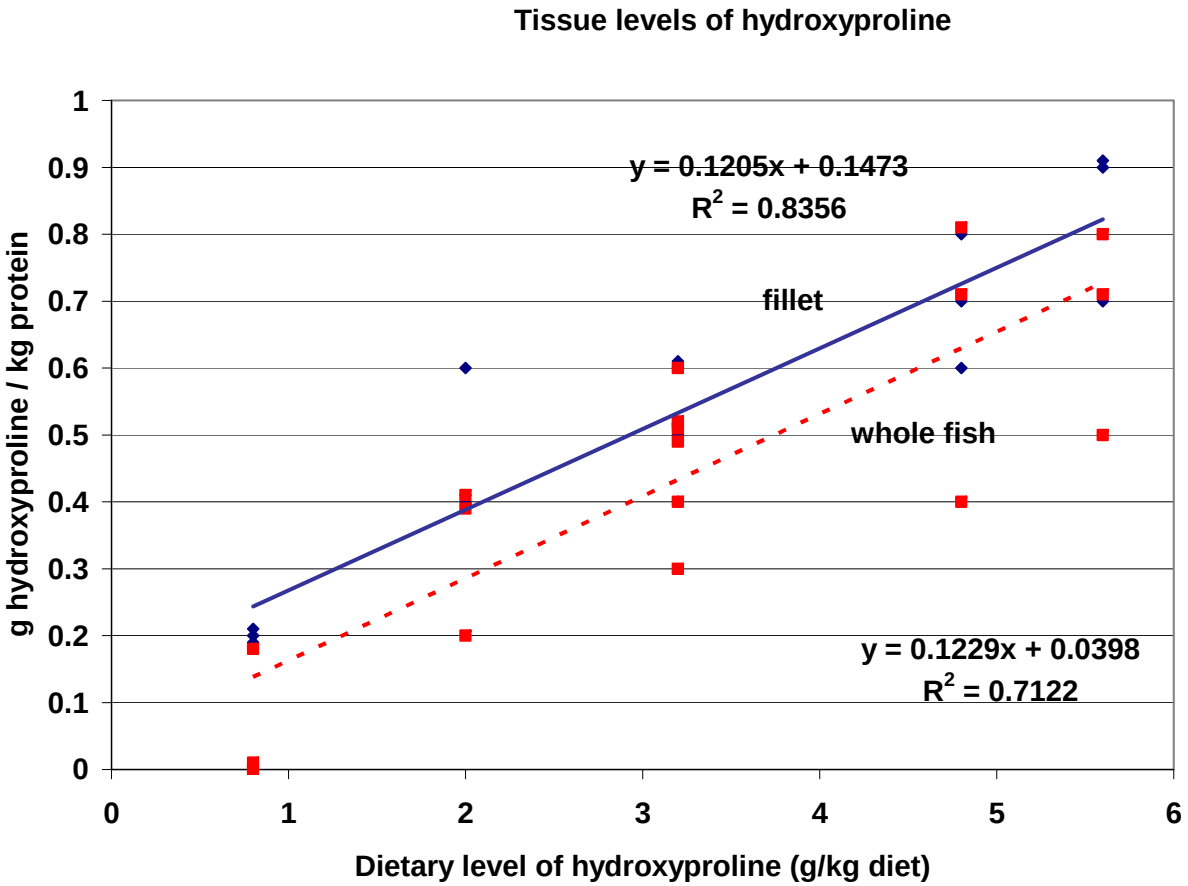
Dietary composition – trout experiment

Diets	Plant Protein 1	Fish hydrol. 2	Fish hydrol. -Small molec 3	Fish meal 4
Soya – Corn Wheat - % of dietary protein	66 91%	39 57%	41 57%	47 57%
Fishmeal	8	8	8	26
Fish hydrolysate	-	24	-	-
FH –removed small molecules	-	-	22	-

Retention of hydroxyproline in trout




Plasmalevels of hydroxyproline
umol per 100 ml plasma
50.00
40.00
30.00
20.00
10.00
0.00
0
1
2
3
4
5
6
Dietary hydroxyproline (g/kg diet)

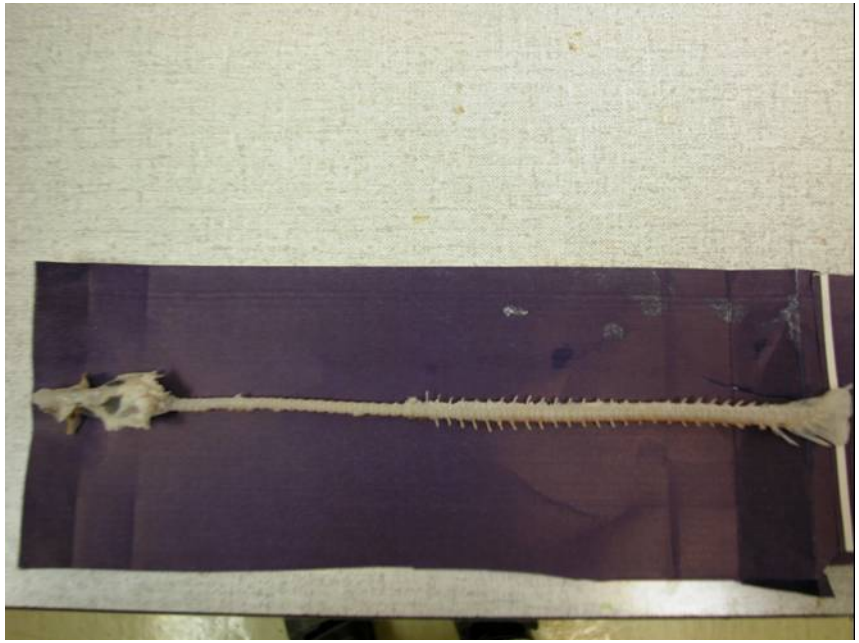

Tissue levels of hydroxyproline
g hydroxyproline / kg protein
Dietary level of hydroxyproline (g/kg diet)
y = 0.1205x + 0.1473
R2 = 0.8356
fillet
whole fish
y = 0.1229x + 0.0398
R2 = 0.7122
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
1
2
3
4
5
6

Hydroxyproline regression – feeding trial with salmon

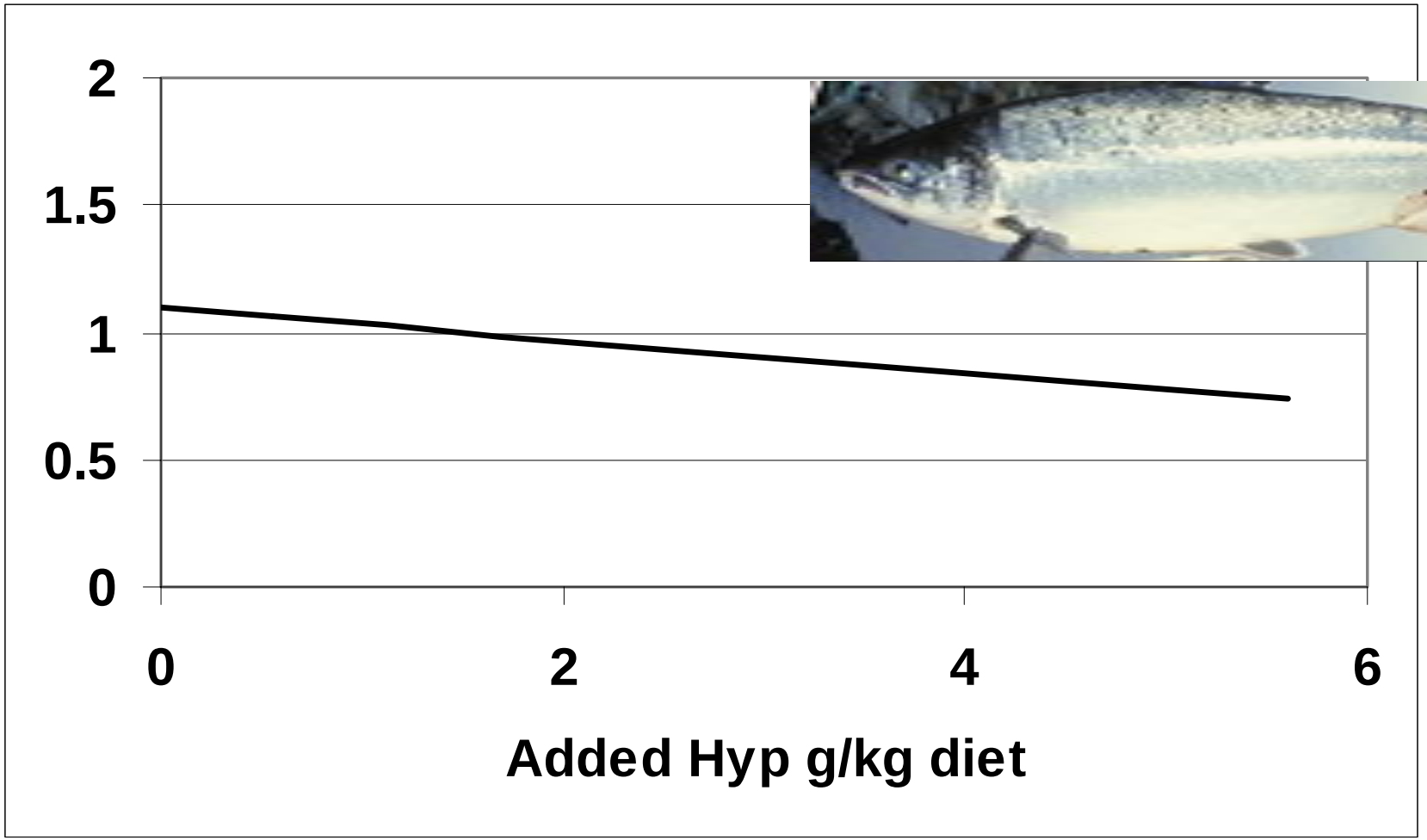
- 5 different levels of hydroxyproline
  - 0, 0.7, 1.4, 2.8, and 5.6 g per kg diet
- 12 weeks growth experiment with salmon

Studies in tissues high in hydroxyproline

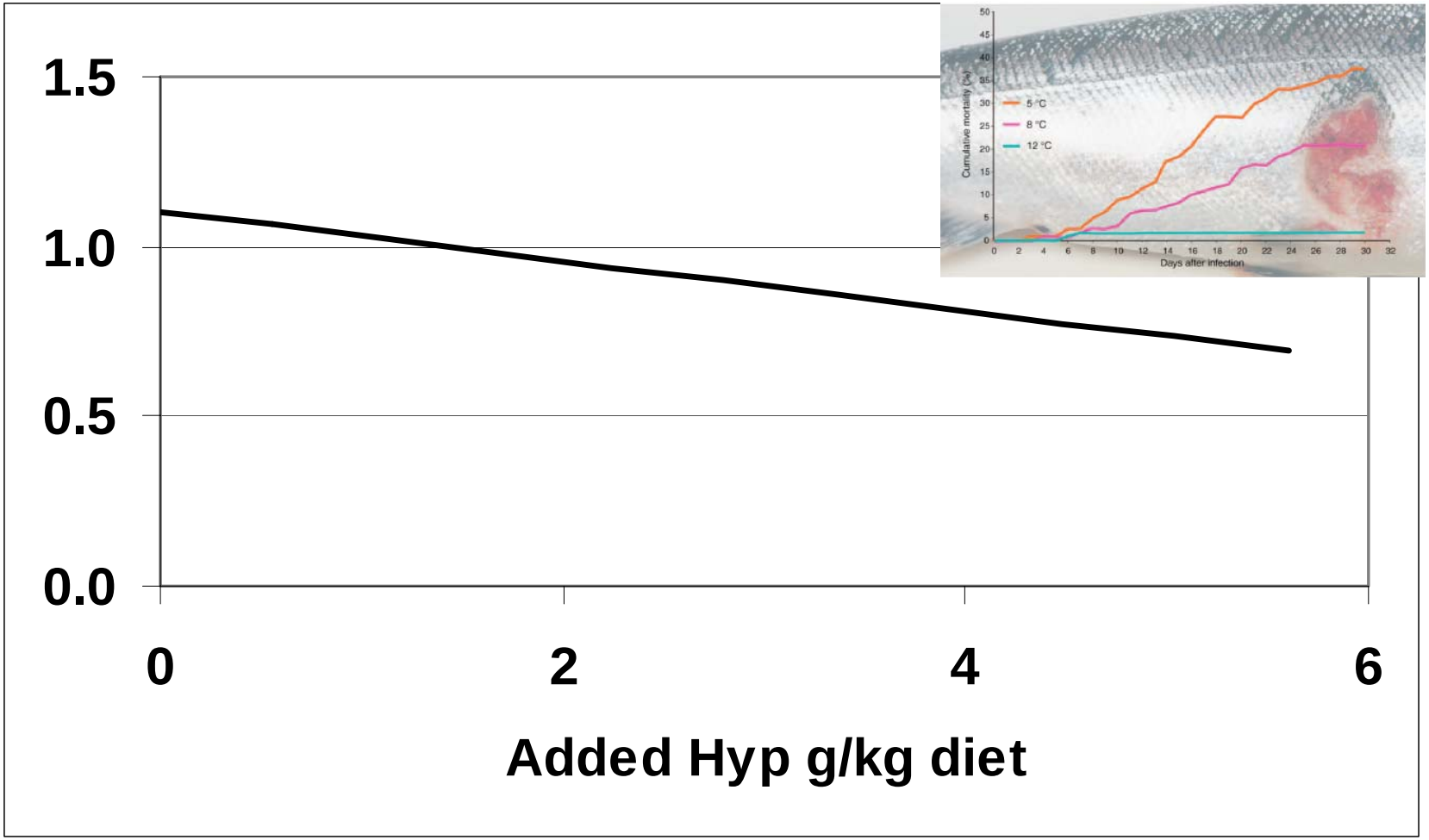
- Bones /vertebrae
- Skin
- Intestine



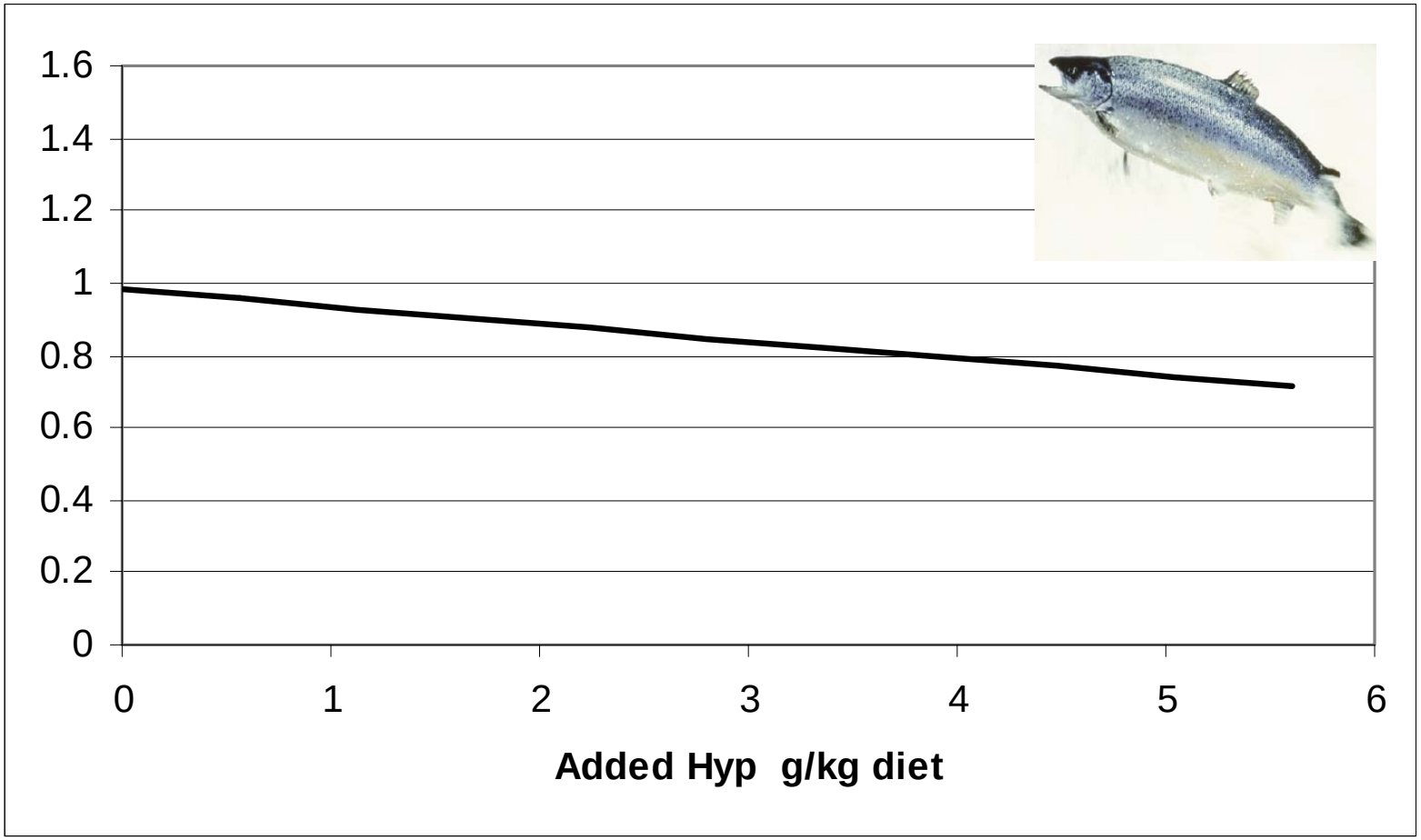
Loss of shell (n=110)



Wounds on skin (n=110)



Injuries on dorsal fin (n=110)



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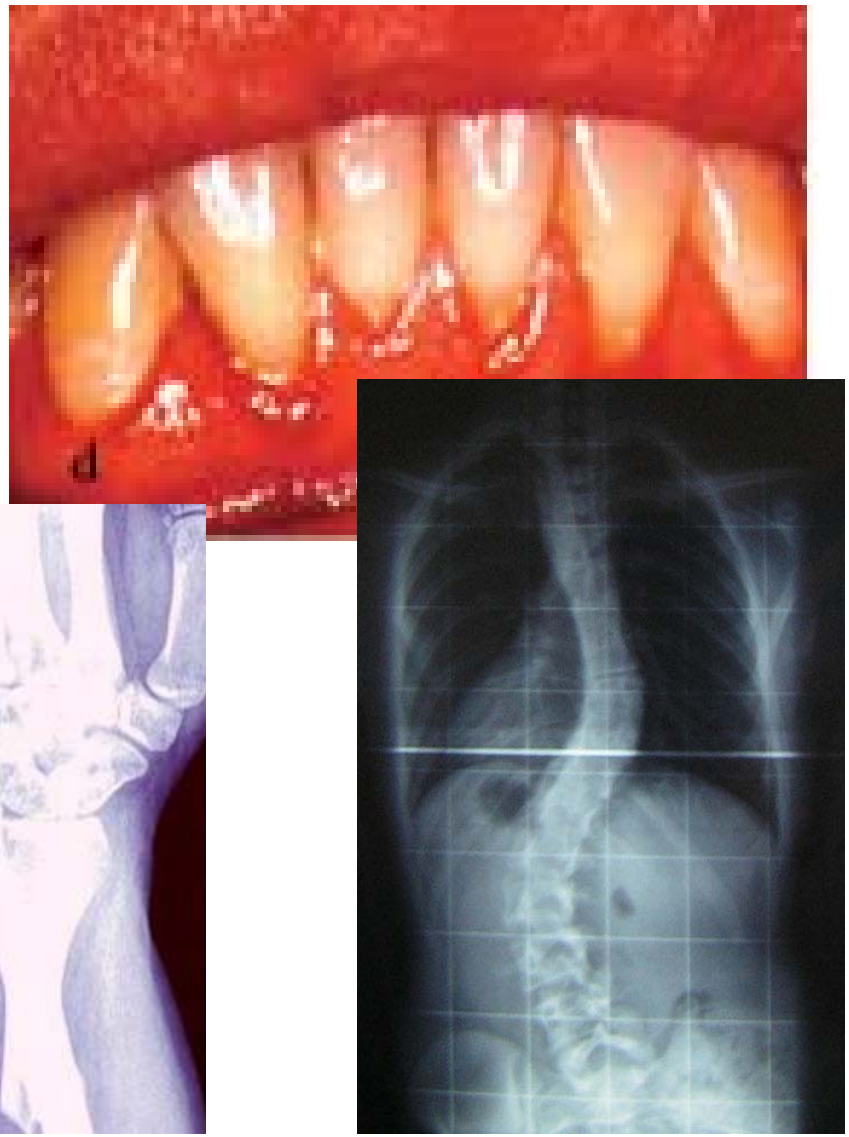
Threonine	2.0 - 4.0	g/100 g protein
Tryptophan	0.3 - 1.4	g/100 g protein
Valine	2.3 - 4.0	g/100 g protein
Hydroxyproline ?	1 - 2	g/100 g protein

Conclusion

- 14% increased growth
- Lower feed price due to higher vegetable and lower fish meal
- Increased interest for by-products
- Potential for less wounds and injuries
- Increased farming yield
- Wounds in intestine ?
- Muscle structure and fillet quality ?

New nutritional knowledge
Other possible effects !

- Chicken feed – bone structure?
- Humans?
  - Osteoporosis?
  - Scoliosis?
  - Gingivitis?
  - Periodontitis?
  - Hear loss?
  - Wound healing and enteritis?



Takk for oppmerksomheten.

Fiskeriforskning Bergen