# Bindevev, frie aminosyrer og mineralenes betydning for tekstur

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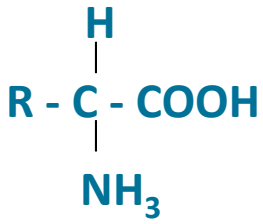
Hell 17.06.09

# IAA's i fiske ernæring

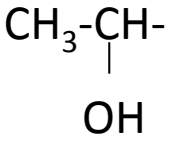
- Behov for 10 AA's
- Andre dyr har behov for 8 (9)

- Fisk har lav ureasyklus og har derfor et behov også for arginin

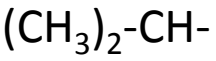
# Indispensable AAs i fisk:



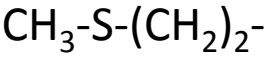

Thr

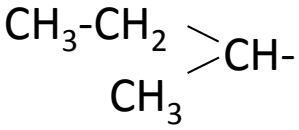



Val

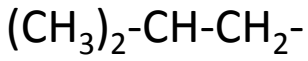



Met

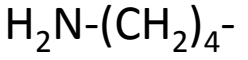


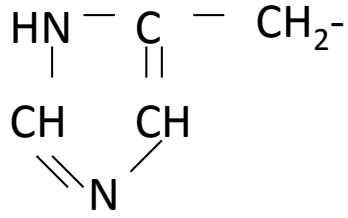

Ile



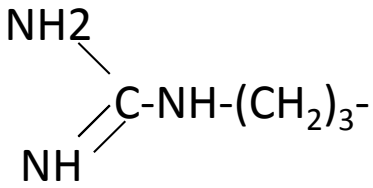

Leu



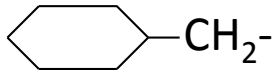

Lys



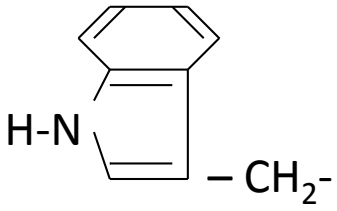

His




Arg




Phe




Trp

**Table 1**. The protein (g/16gN), total- and free amino acid content (mg/g protein) in domestic animals (beef) and fish muscle. The free amino acids constitutes minor amount.

| AA's | Total AA's | | Free AA's | | % free of total | |
|---|---|---|---|---|---|---|
| | Beef[1] | Fish muscle[1] | Beef[2] | Fish muscle[3] | Beef | Fish muscle |
| Protein | 20-23 | 20-22 | - | - | - | - |
| Met* | 23 | 30 | 0.15 | 0.10 | 0.65 | 0.44 |
| Lys* | 85 | 89 | 0.62 | 0.65 | 0.73 | 0.73 |
| Thr* | 40 | 45 | 0.15 | 0.24 | 0.39 | 0.38 |
| Val* | 59 | 51 | 0.28 | 0.20 | 0.47 | 0.40 |
| Ile * | 52 | 49 | 0.37 | 0.08 | 0.71 | 0.16 |
| Leu* | 83 | 80 | 0.80 | 0.24 | 0.96 | 0.30 |
| Trp* | 11 | 12 | 0.009 | - | 0.08 | - |
| Phe* | 41 | 43 | 0.37 | 0.16 | 0.91 | 0.37 |
| His(*) | 32 | 34 | 0.47 | 1.24 | 1.48 | 3.65 |
| Arg* | 67 | 63 | 0.90 | 0.12 | 1.34 | 0.19 |
| Tyr | 33 | 36 | 0.43 | 0.30 | 1.32 | 0.83 |
| Gly | 73 | 49 | 0.21 | 0.90 | 0.29 | 1.84 |
| Ser | 40 | 41 | 0.35 | 0.14 | 0.88 | 0.34 |
| Pro | 56 | 36 | 0.16 | 0.15 | 0.29 | 0.42 |
| Ala | 60 | 64 | 1.49 | 1.20 | 2.49 | 1.88 |
| Asp | 88 | 97 | 0.11 | 0.07 | 0.12 | 0.07 |
| Glu | 149 | 152 | 2.70 | 0.83 | 1.81 | 0.55 |
| ΣAA's | 991 | 971 | 9.57 | 6.62 | 0.96 | 0.68 |
| NPN | 9 | 29 | - | - | - | - |

*Regarded essential for the human being. [1]Adopted from Espe, 2008; [2] Adopted from Koutsidis et al., 2008 (stored 10 days) [3] Espe, unpublished result (stored 5 days), Glu and Asp is the sum of amide and acid.

# Fôrigrediensene har endret seg

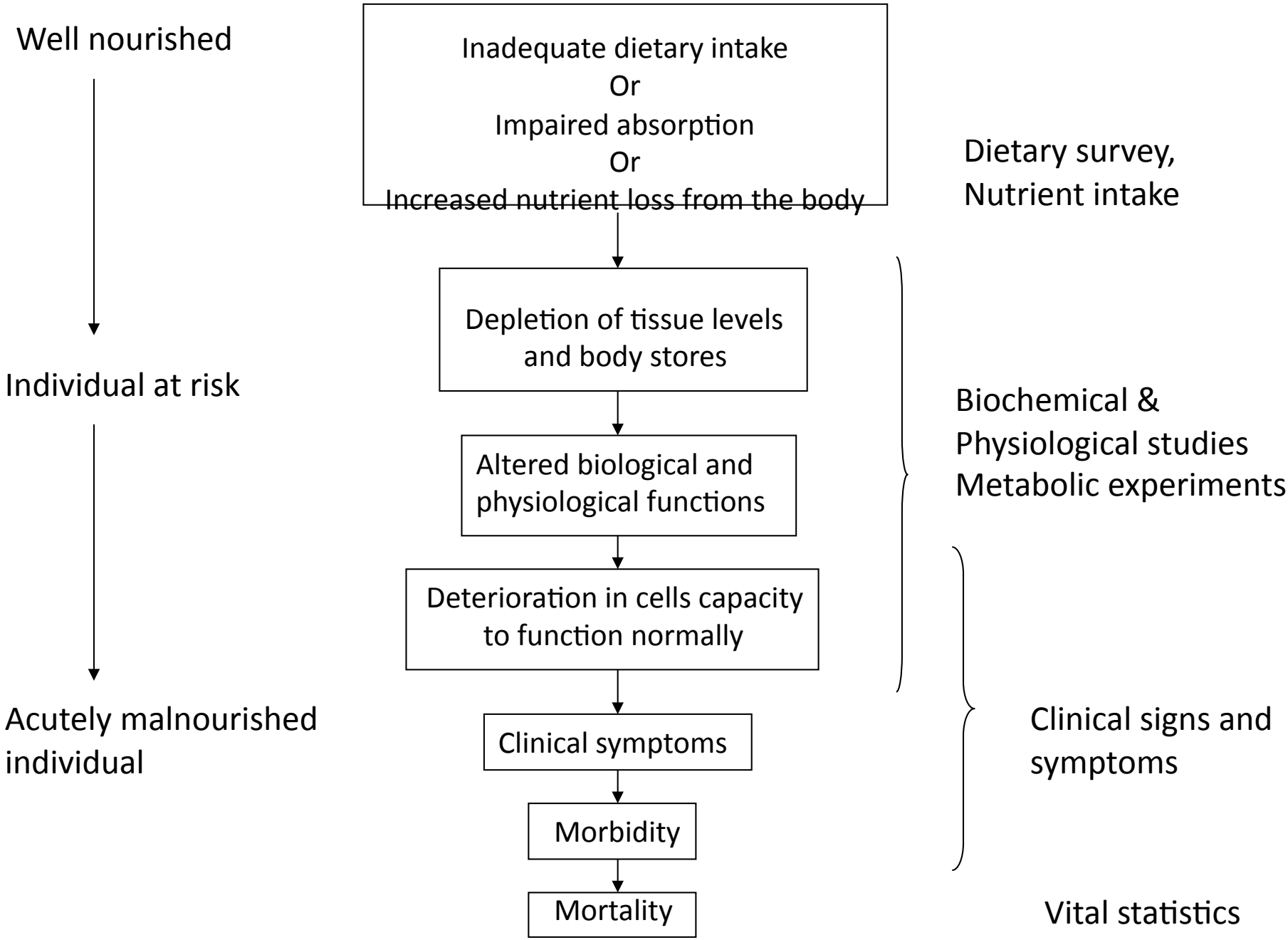
Dyr har ikke egentlig et proteinbehov

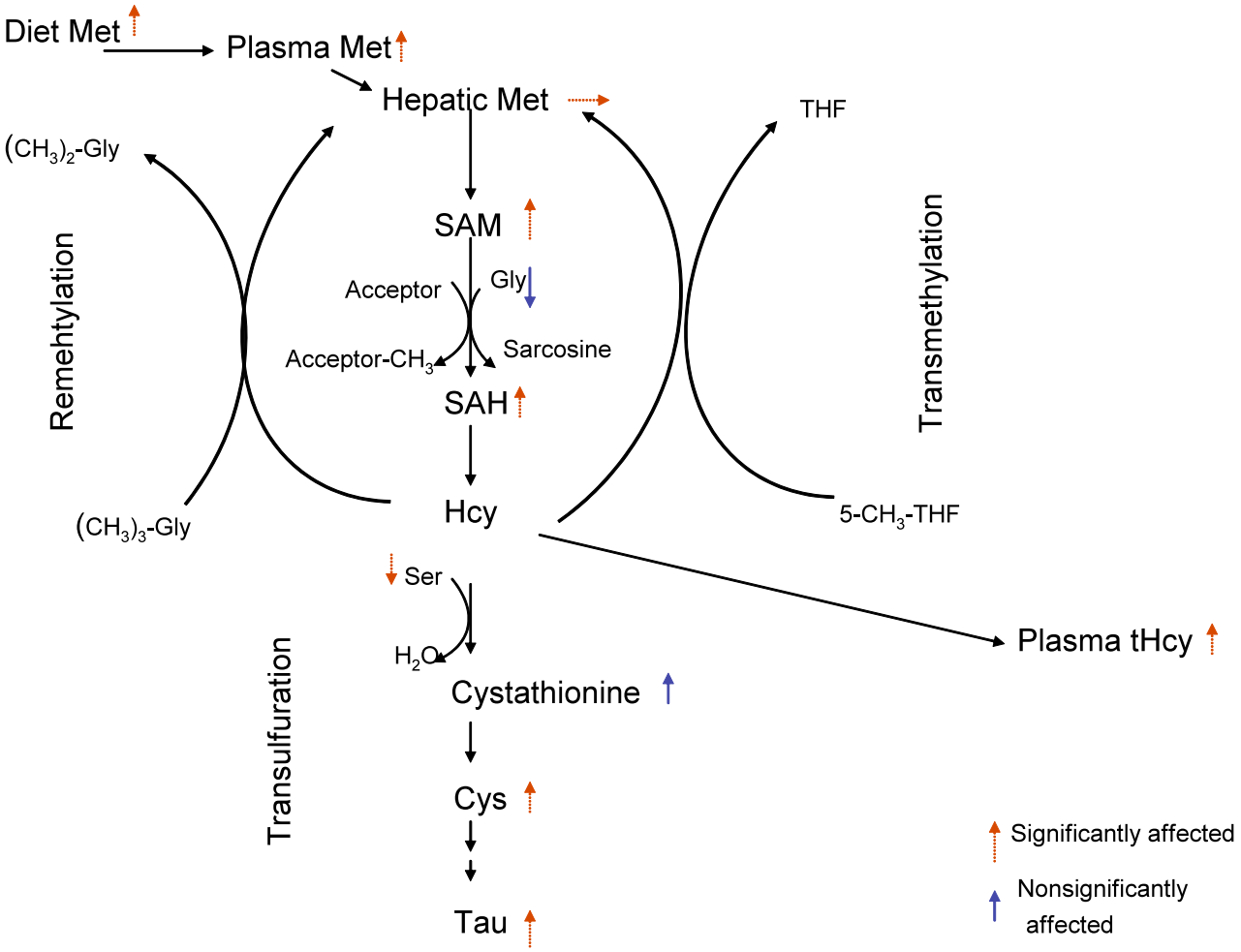
Har behov for en balansert AA-profil

AA-profil ulik i ulike foringredienser

Ikke aminosyre nitrogen (non AA-N) er forskjellig i ulike ingredienser

| AAs (g/16gN) | fish meal | poultry by-products | bloodmeal | cormgluten | soyprotein |
|---|---|---|---|---|---|
| IAA | 43,9 | 38,3 | 54,2 | 44,1 | 44,9 |
| DAA | 48,0 | 54,3 | 45,5 | 61,9 | 52,3 |
| IAA/DAA | 0,91 | 0,71 | 1,19 | 0,71 | 0,83 |
| TSAA | 3,7 | 3,3 | 2,3 | 4,1 | 2,9 |
| TAAA | 9,5 | 10,5 | 10,8 | 11,3 | 8,9 |
| **Non AA-N** | **8** | **7** | **0** | **0** | **0,7** |
| Lys/Arg | 1,3 | 0,8 | 2,0 | 0,5 | 0,8 |
| Met/Cys | 2,9 | 1,0 | 1,0 | 1,4 | 1,0 |
| Leu/Ile | 1,8 | 1,9 | 10,6 | 4,3 | 1,8 |
| Leu/Val | 1,5 | 1,7 | 1,5 | 3,8 | 1,7 |
| Gly/Ser | 1,6 | 2,0 | 0,9 | 0,5 | 0,8 |
| Lys/His | 2,9 | 2,7 | 1,4 | 0,8 | 2,1 |
| TSAA/Lys | 0,5 | 0,7 | 0,3 | 2,6 | 0,5 |
| TAAA/Lys | 1,3 | 2,1 | 1,3 | 7,2 | 1,5 |


Well nourished
Individual at risk
Acutely malnourished individual
Inadequate dietary intake
Or
Impaired absorption
Or
Increased nutrient loss from the body
Depletion of tissue levels and body stores
Altered biological and physiological functions
Deterioration in cells capacity to function normally
Clinical symptoms
Morbidity
Mortality
Dietary survey,
Nutrient intake
Biochemical &
Physiological studies
Metabolic experiments
Clinical signs and symptoms
Vital statistics



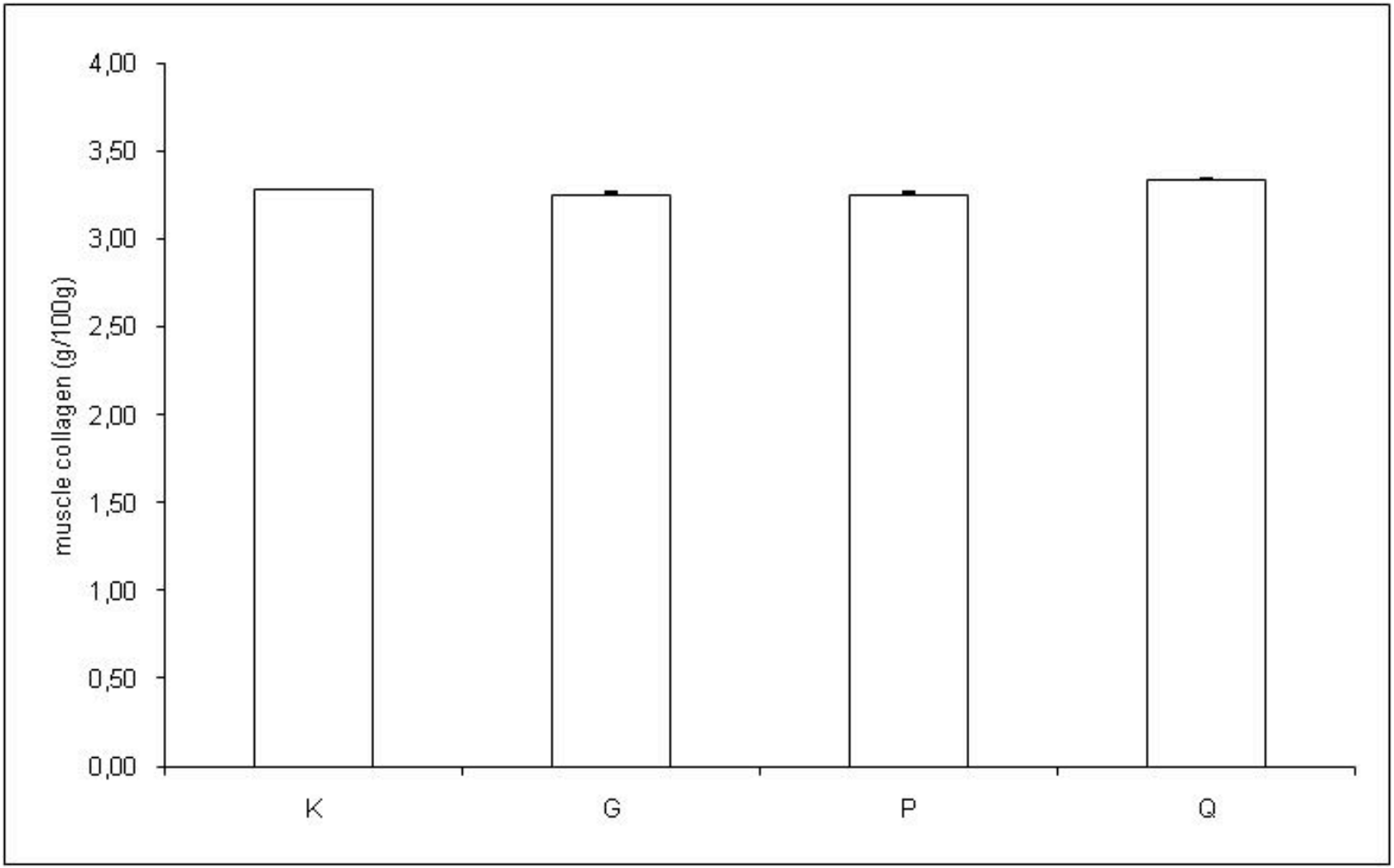

MCD dietter er kjent å gi fettlever,
Met mangel gir fettlever hos laks

From Espe et al, 2008

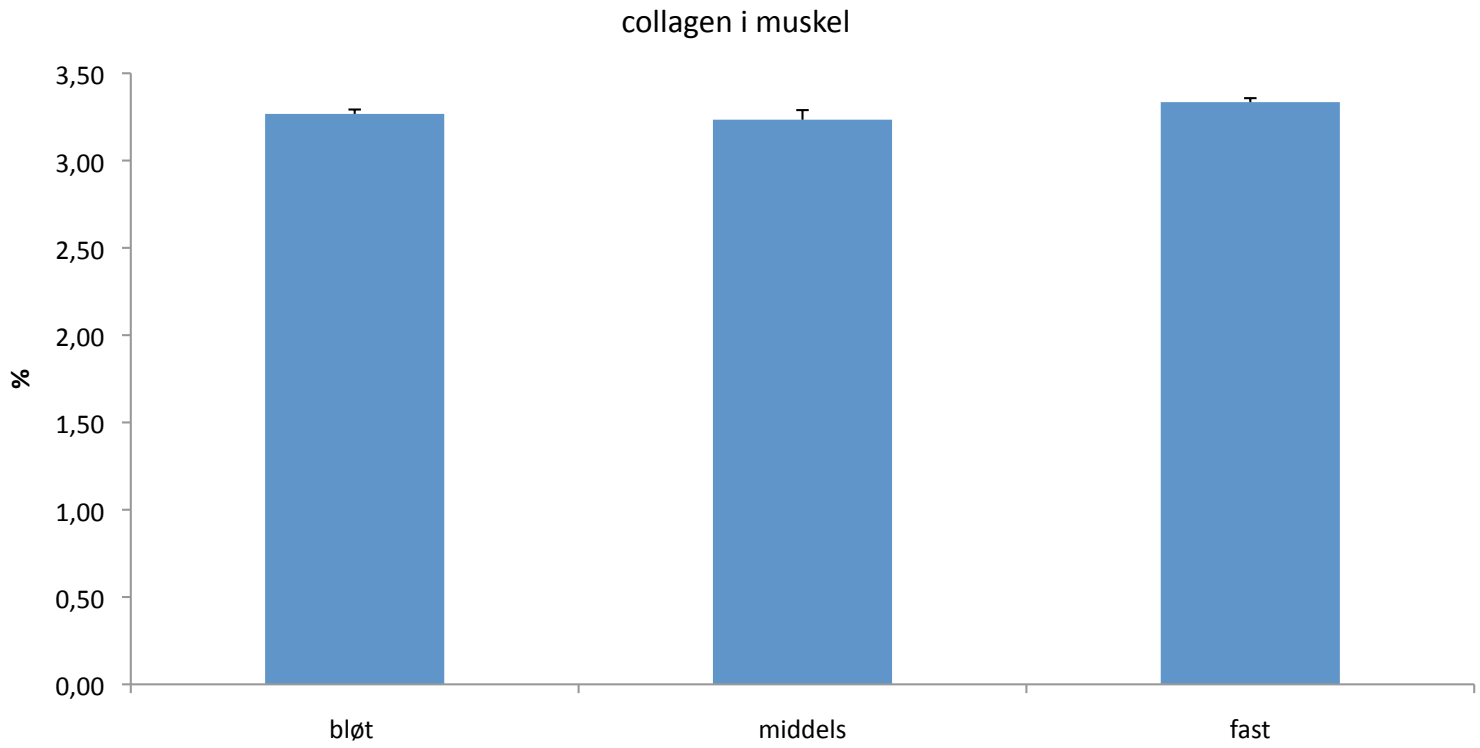
# Frie aminosyrer og metabolitter,- ulike lokaliteter

- Atlantisk laks fra fire ulike lokaliteter
  - K, Q, P & G
- Frie N metabolitter i NQC
  - Samme prøver som analysert av NOFIMA
- Total collagen
  - Differansen total og fri OH-pro, (OH-pro*11.42; Sato et al. 1991)
- Frie N metabolitter i 3 ulike områder av fiskemuskelen
  - Bare for noen av fiskene grunnet at ikke tatt ut for alle gruppene
  - Fremme i muskel i bløt stripe og over bløt stripe
- Mineraler (Cu, Zn, Se)

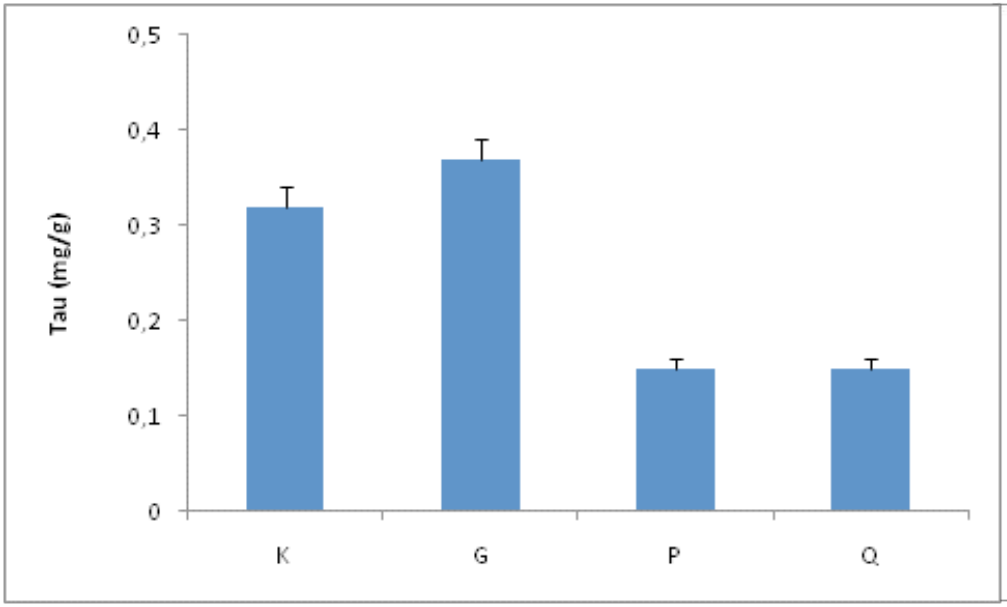
# Bindevev ulike lokaliteter

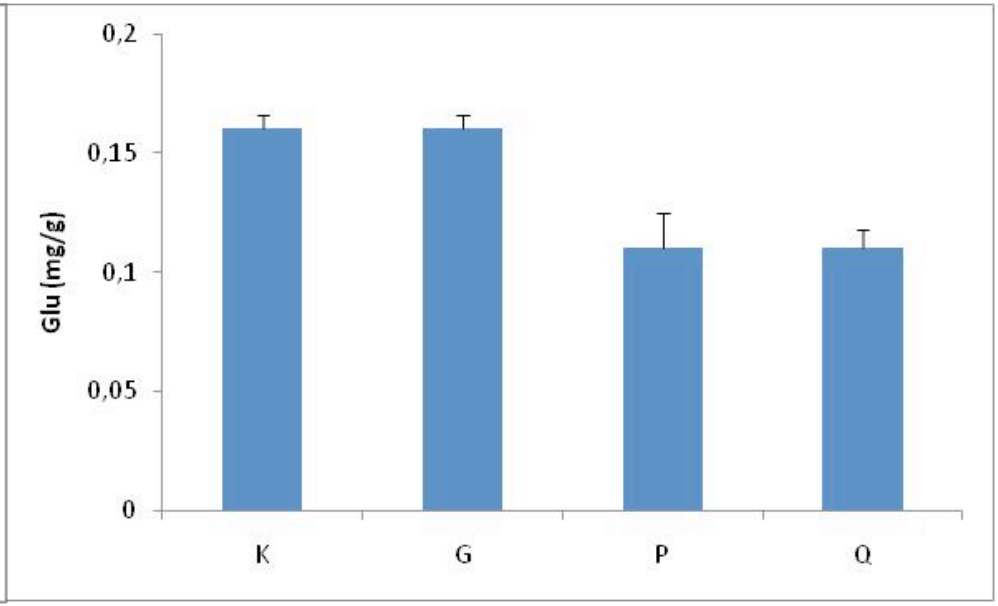


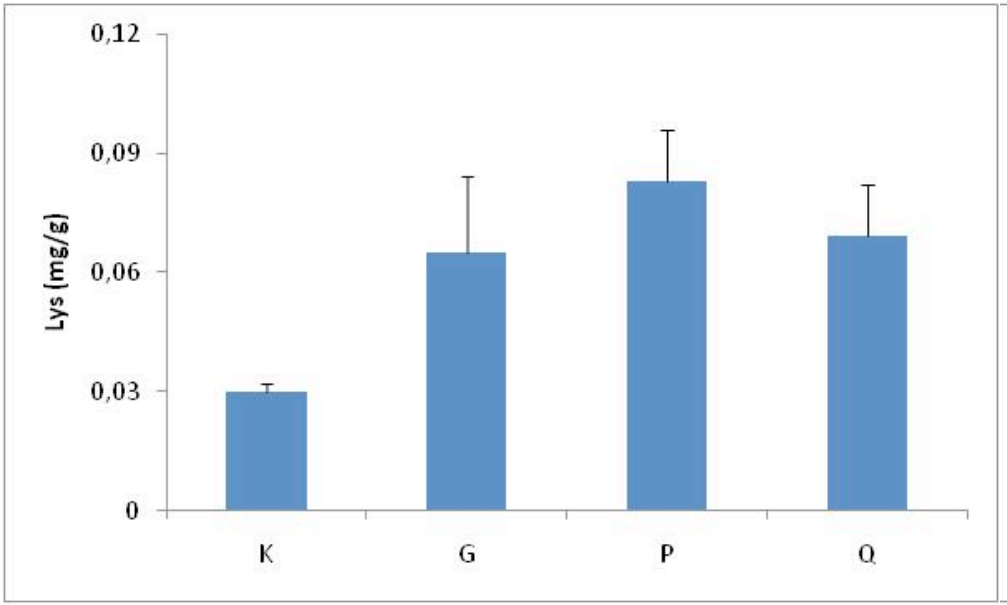
# Total collagen ikke påvirket ved bløthet

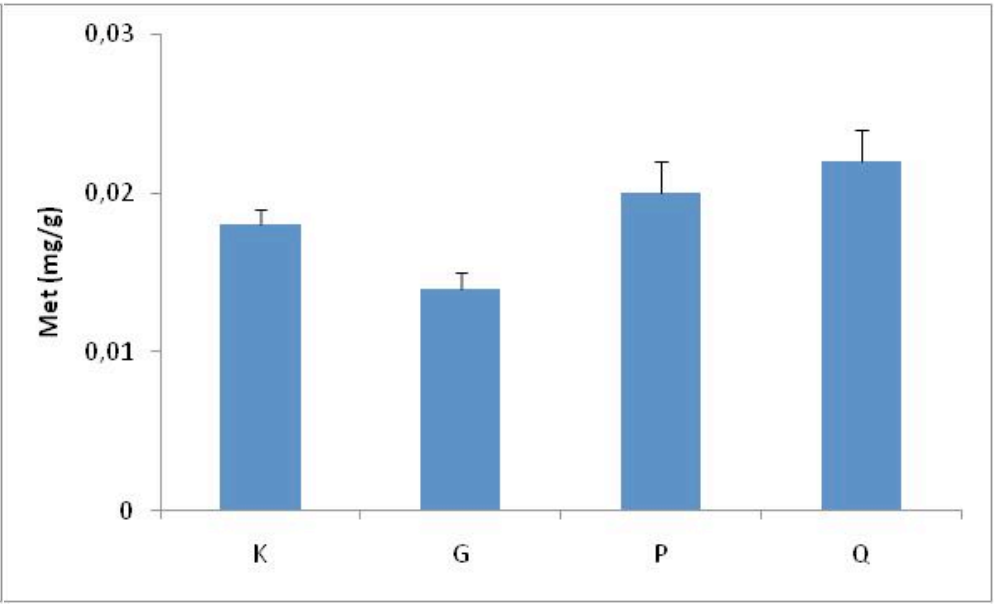


# AA og metabolitter ulike lokaliteter

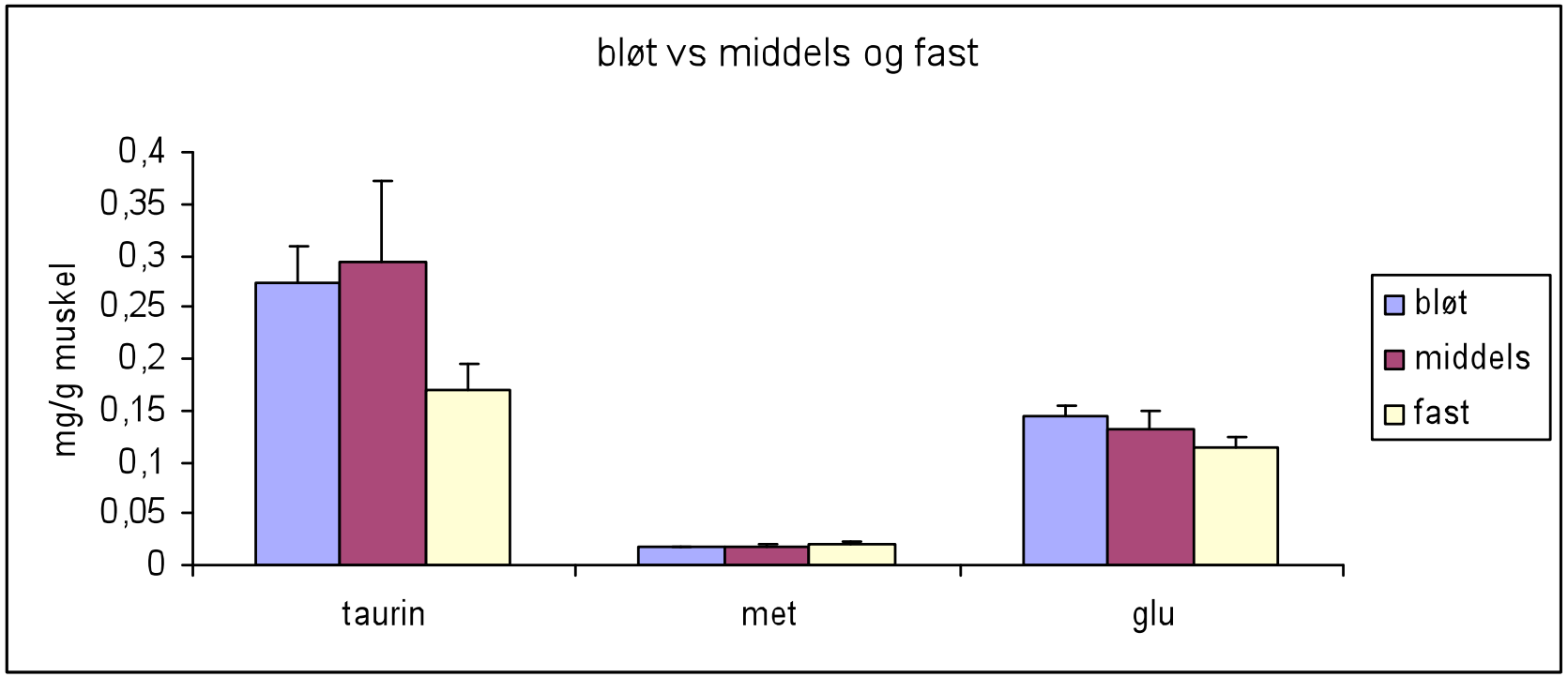


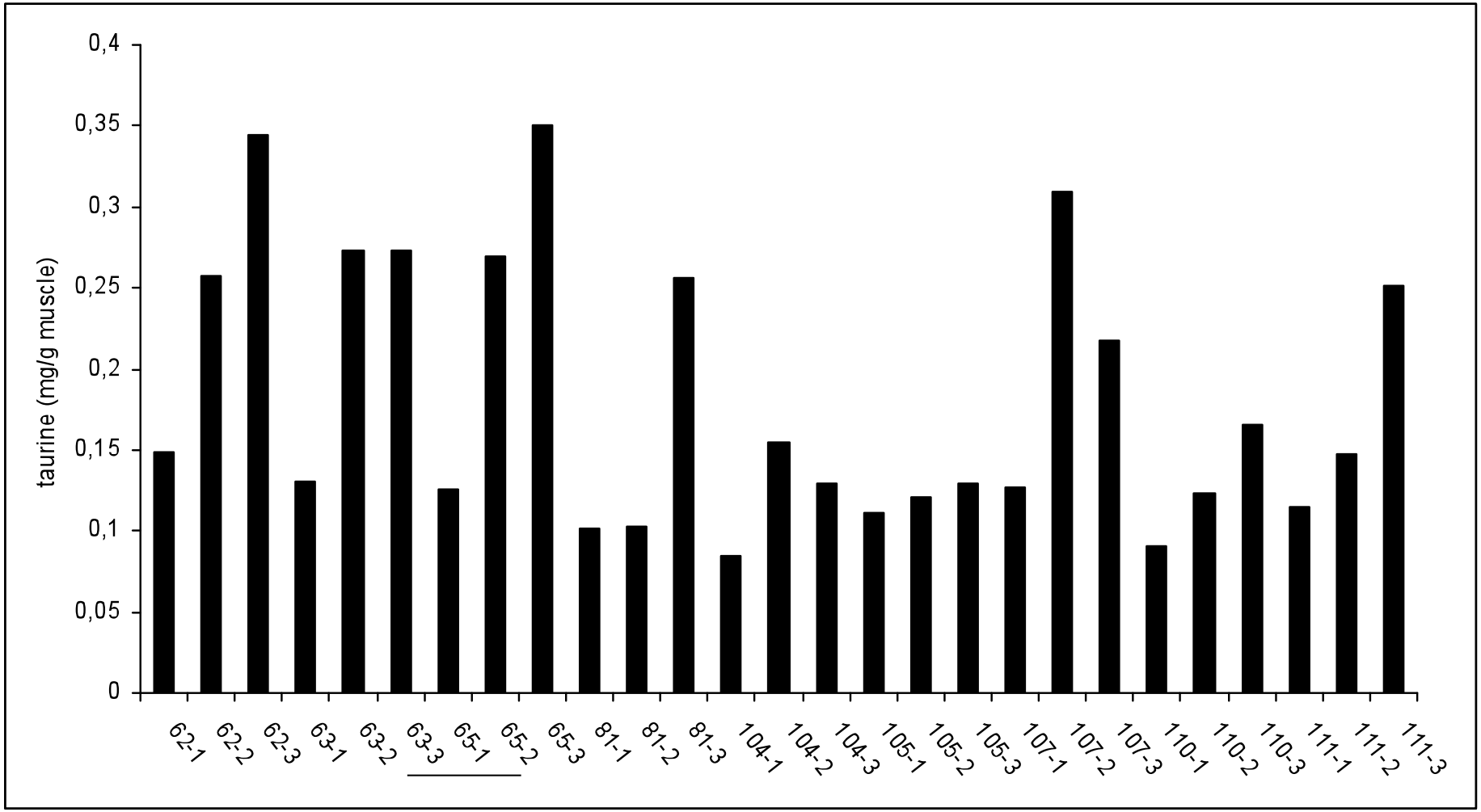



# Mean taurine, metionin og glutamat i bløt vs middels vs fast textur:



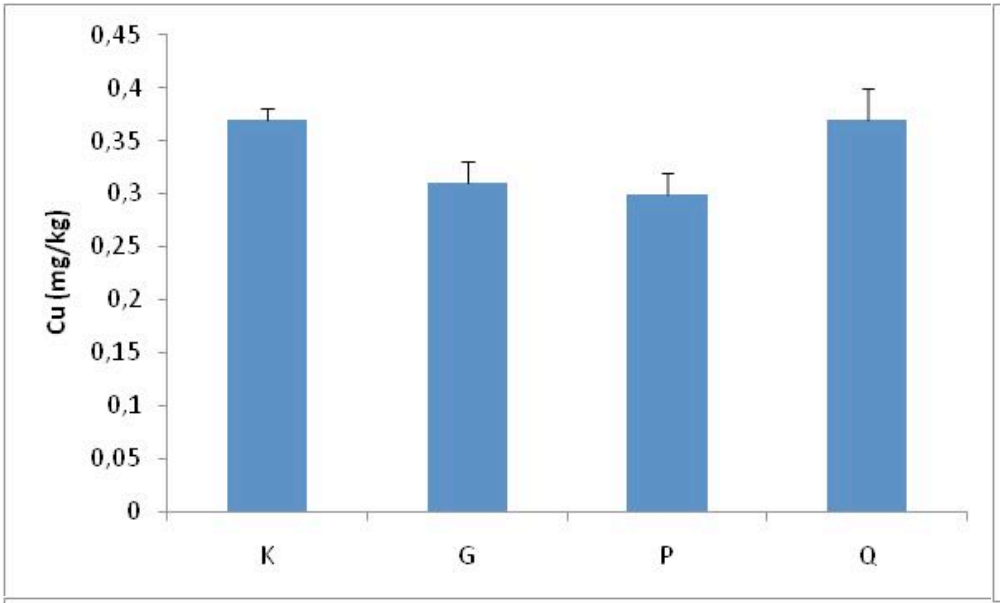

Bløt er 11 fisker
Middels er 3 fisker
Fast er 6 fisker

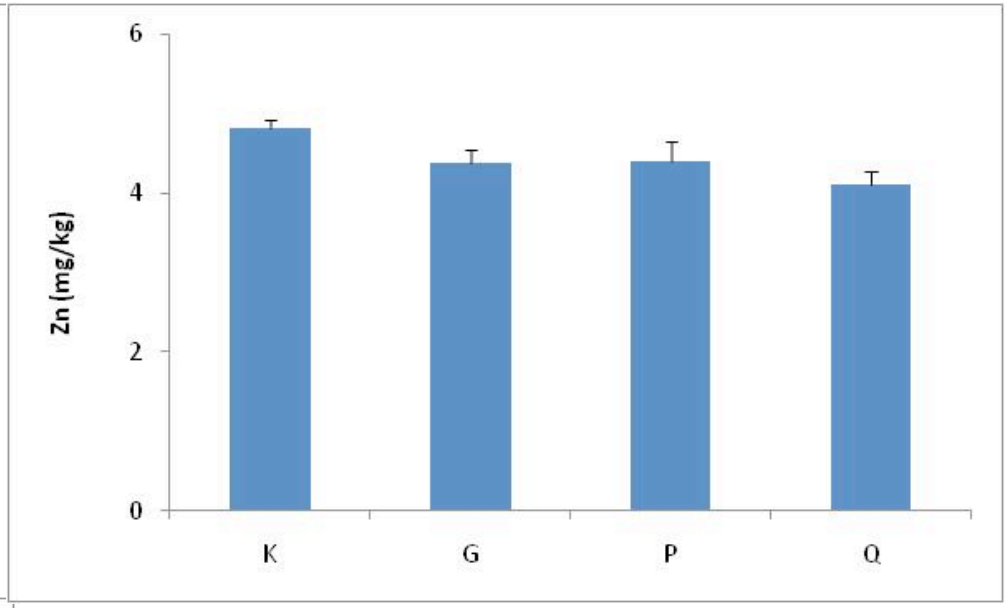
# Taurin i ulike område av laksemuskelen, stor variasjon

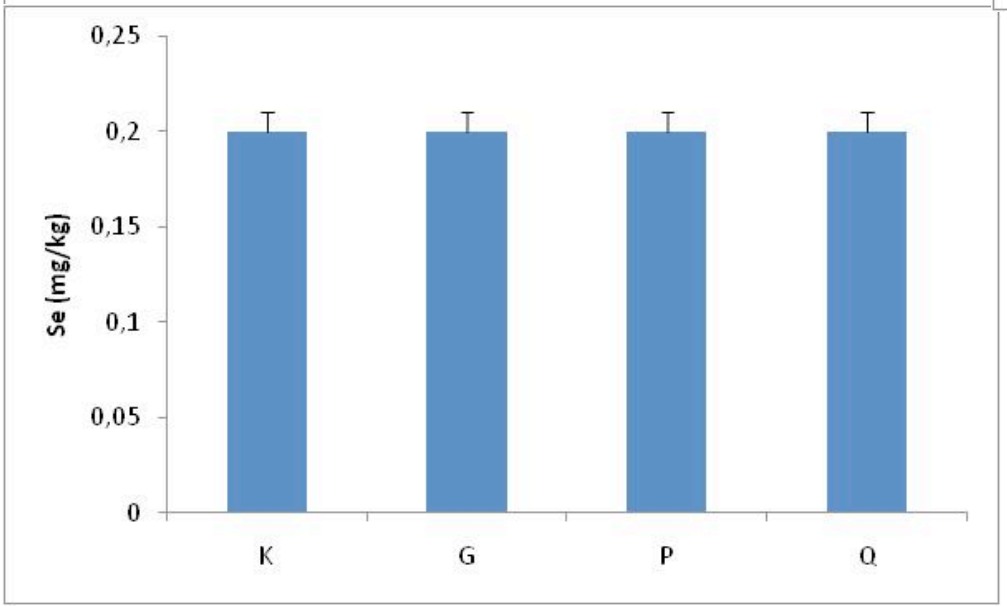



1 er foran ryggfinnen, 2 er sidelinja rett ovenfor gattet, 3 er bløt stripe

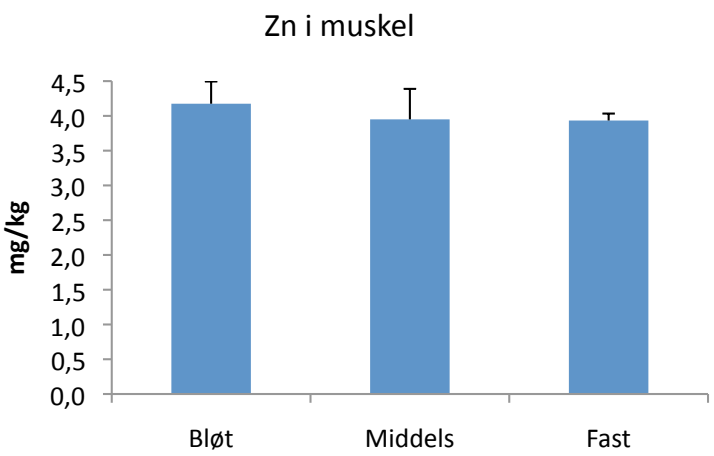
# Mineraler ulike lokaliteter

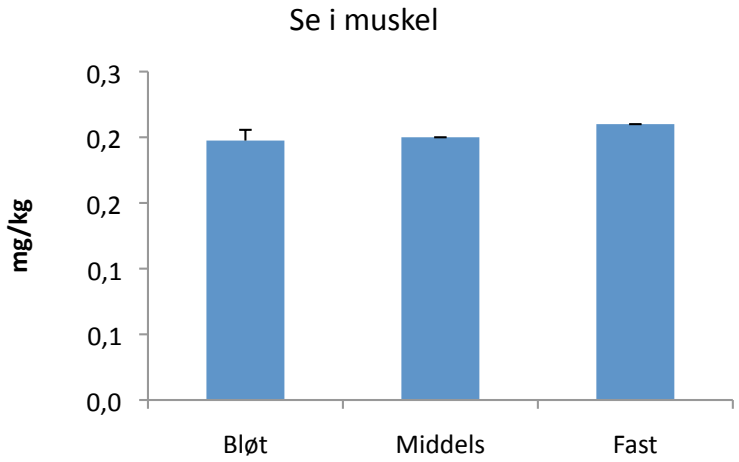


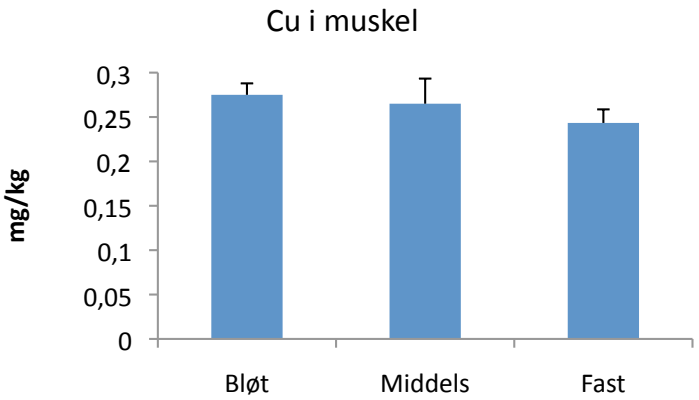



# Mineraler (Zn,Se & Cu)



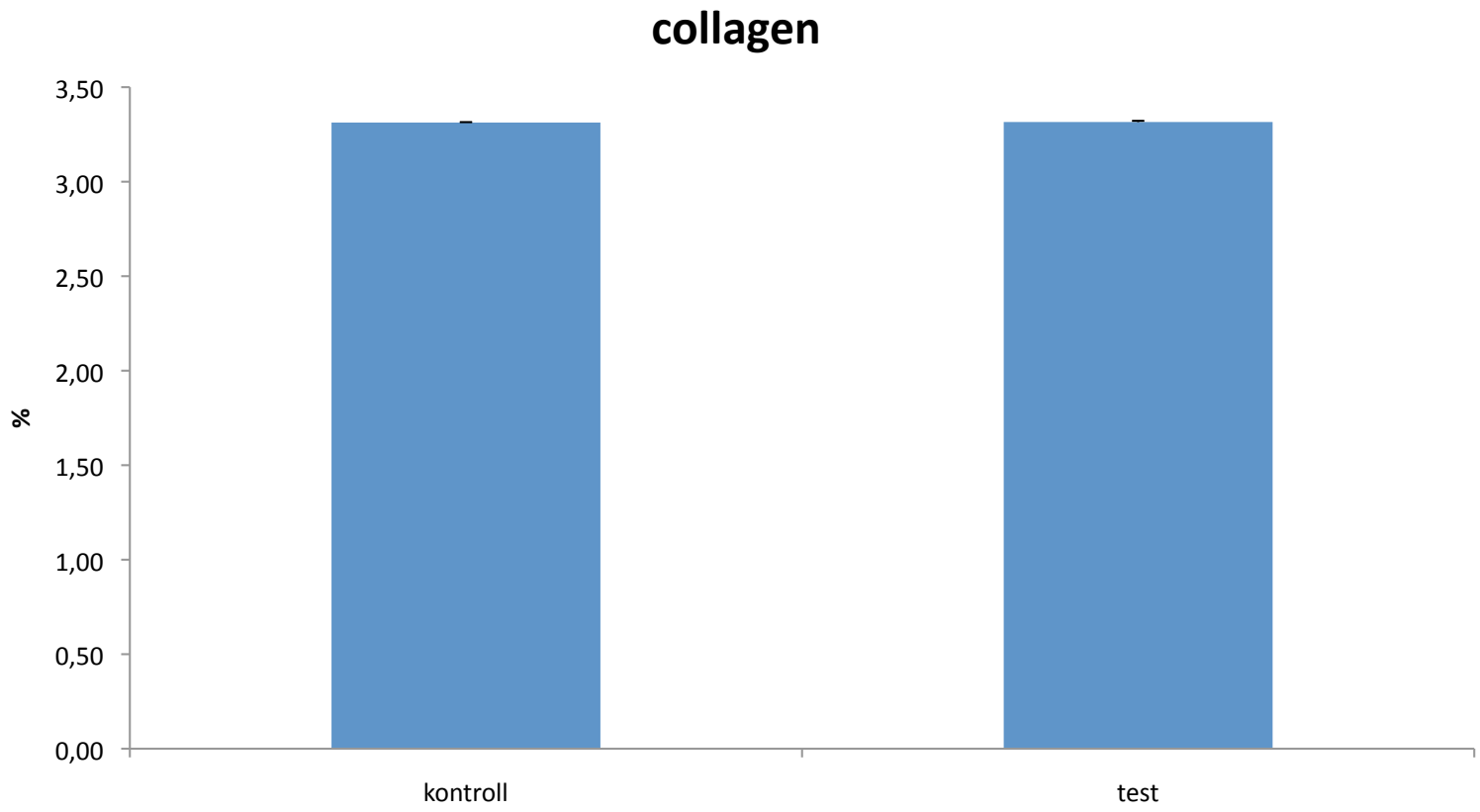



# Forsøk ved NOFIMA

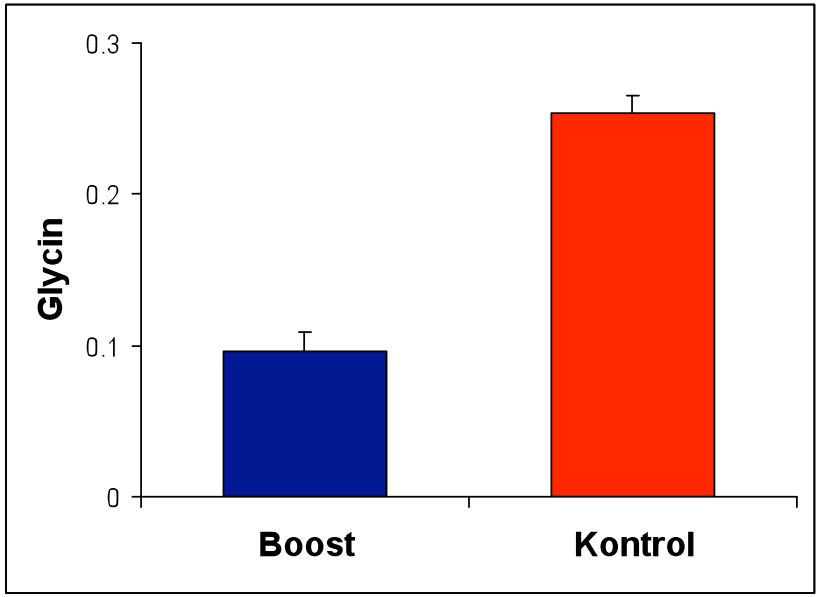
- Muskelprøver tilsendt fra forsøk i NOFIMA
  - Kontroll vs ”boosted”
- Prøver fra NQC
  - Total collagen
  - Aminosyrer og Metabolitter
  - Mineraler (Zn, Se & Cu)
- Gått i merder (triplikater, 5 fisk pr merd analysert)

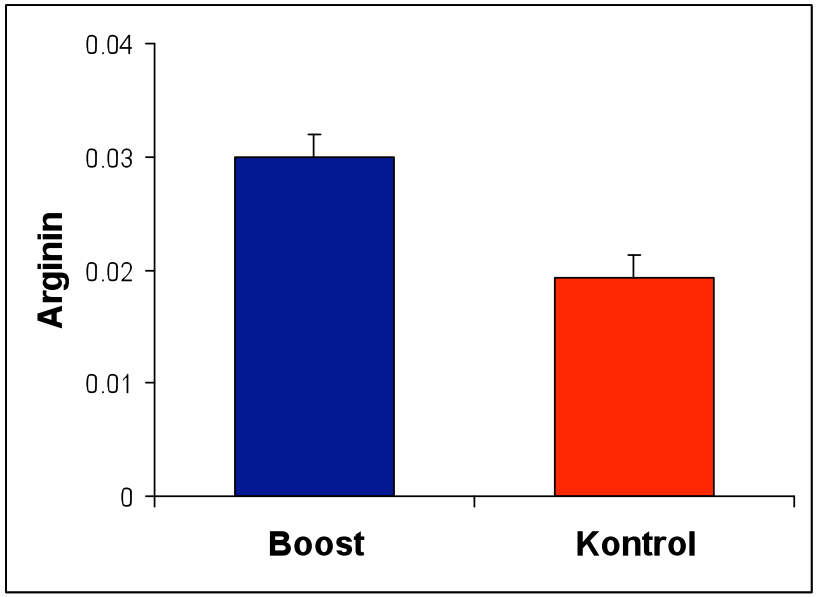
# Total collagen

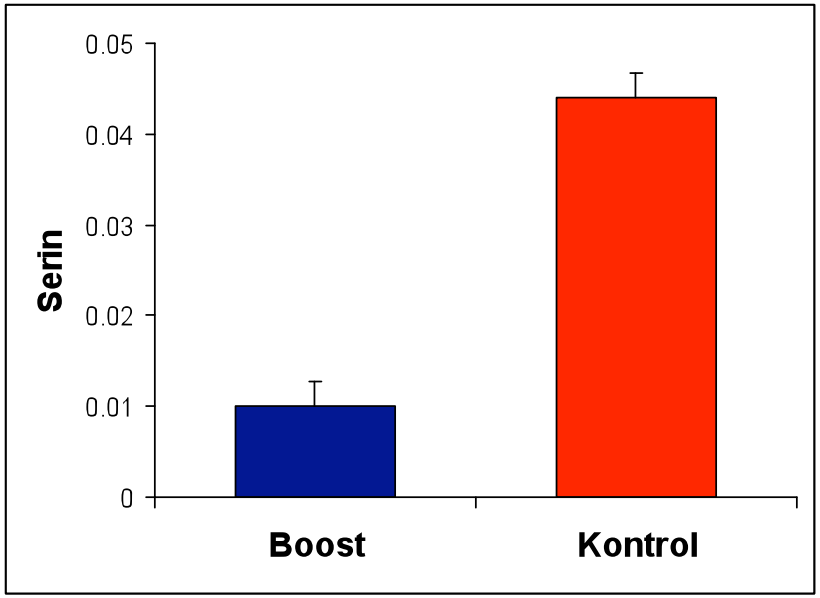


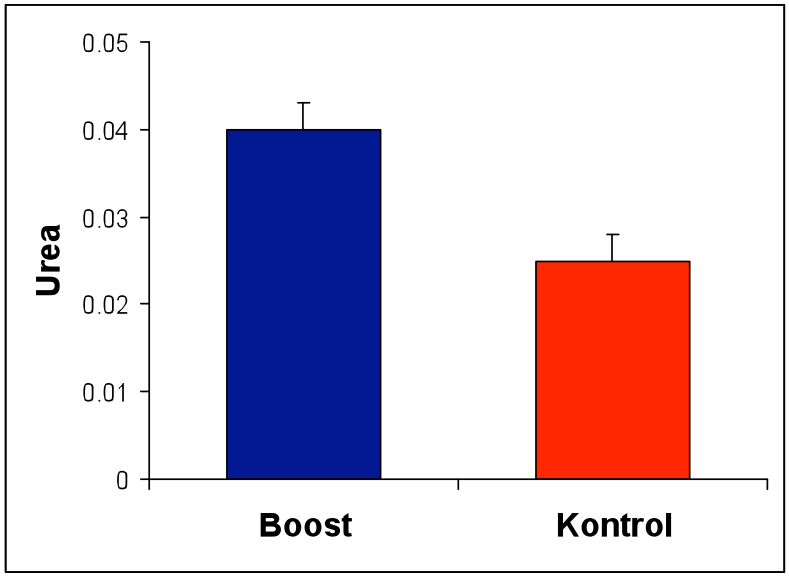
# Frie aminosyrer

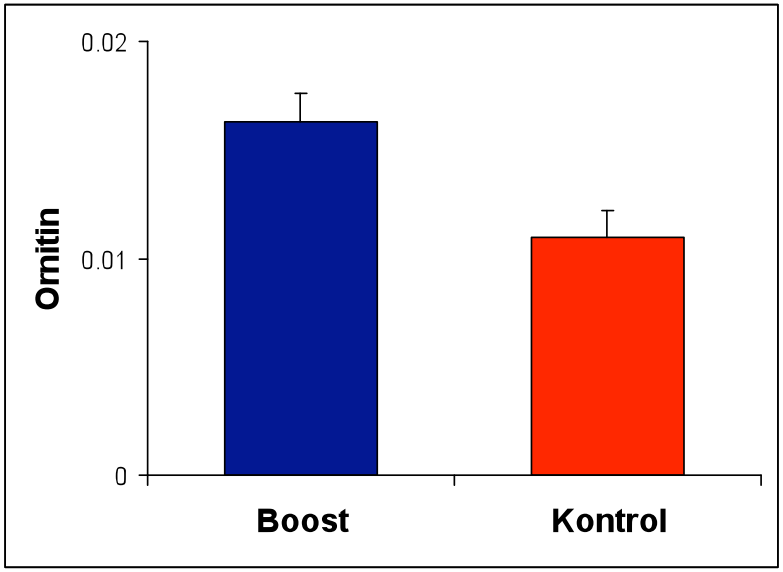
# i muskel



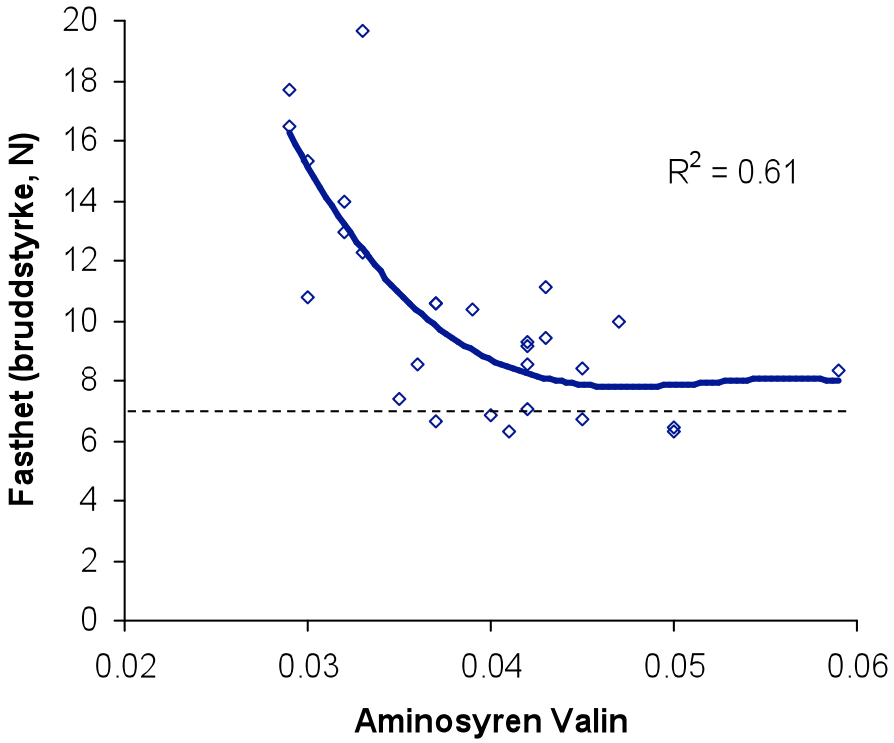

Urea
0.05
0.04
0.03
0.02
0.01
0
Boost
Kontrol


Ornitin
0.02
0.01
0
Boost
Kontrol

# Fasthet vs mengde frie aminosyrer i muskel

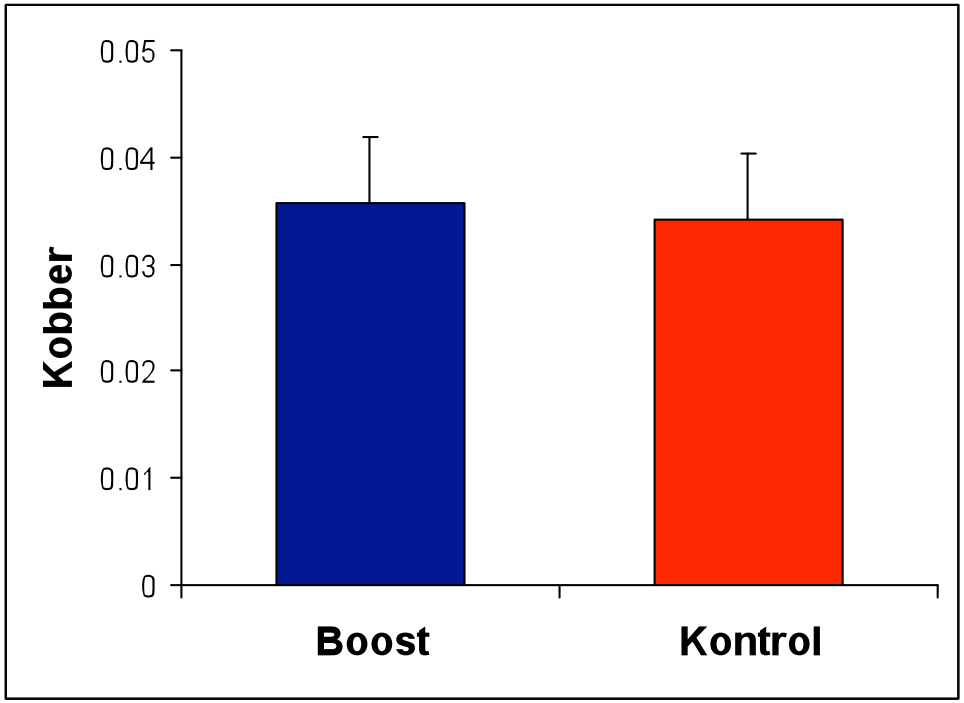
| Aminosyre | Korrelasjon* |
|---|---|
| Val | -0.75 |
| β-Ala | -0.69 |
| Ile | -0.66 |
| Asp | -0.62 |
| Leu | -0.61 |
| 1-methyl-His | -0.61 |
| Met | -0.53 |
| Phe | -0.5 |
| Glu | -0.43 |
| Tau | -0.4 |
| Phosphoetanolamin | -0.38 |
| Tyr | -0.32 |
| Thr | 0 |
| Glu | 0 |

Jo mer frie AA desto bløtere muskel




*Kraft ved 60% nedtrykk, n = 30

# Mineraler ingen forskjell



# Konklusjon

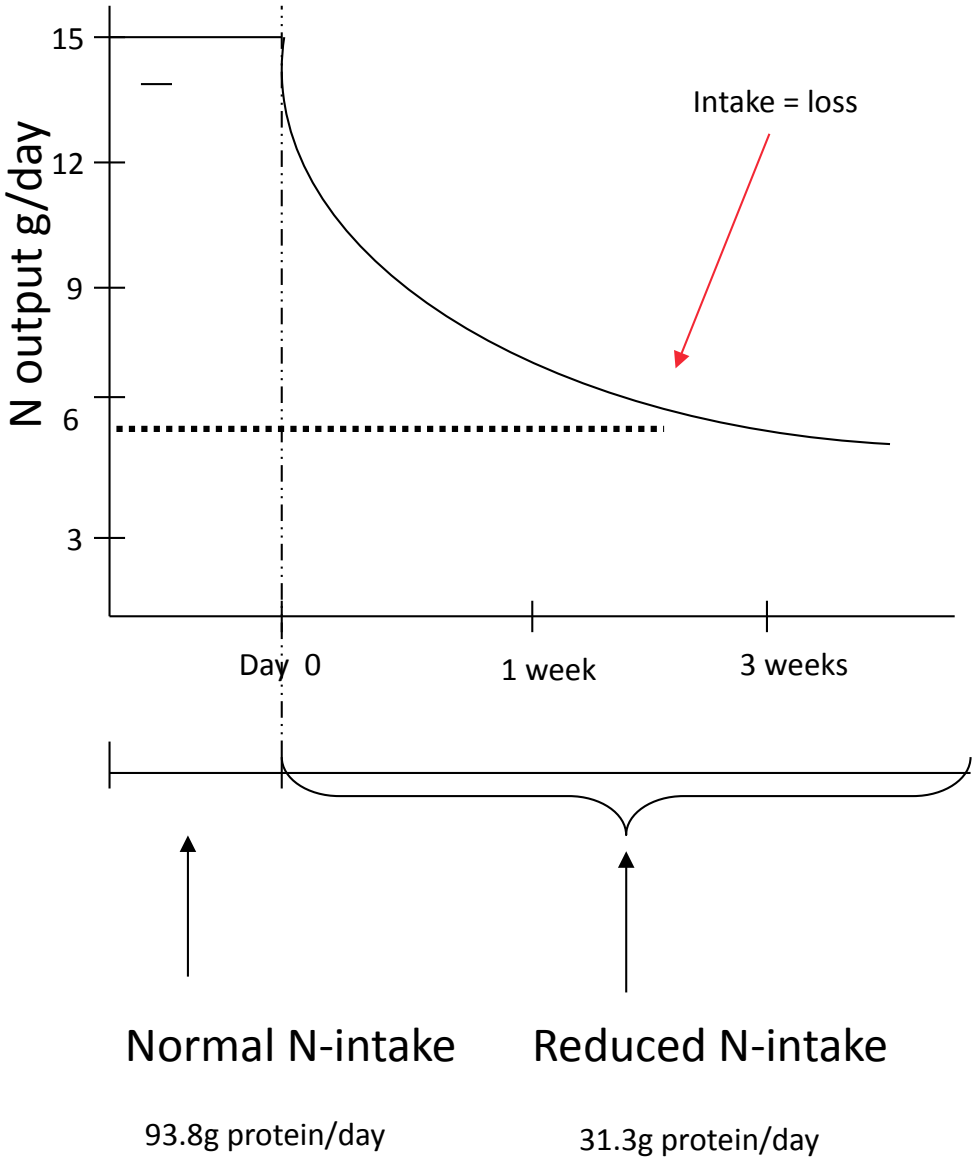
- Total mengde bindevev synes ikke å være endret
- Tidligere sett at Cu og Zn er relatert til bløthet
  - Ikke signifikante endringer i mineraler
- Det er en korrelasjon mellom frie aminosyrer og bløthet
  - Jo mer frie aminosyrer, jo bløtere fisk
- Økt nedbrytning av protein
- Endret membranstabilitet???

# Hele metabolismen må studeres

- Kan det være en ubalanse i næringstoffer?
- Livsviktige organ prioriteres
  - Lever, hjerte, hjerne, nyre

- Muskelen er et ”stort lager” stor tilpasningsevne

- Hvordan mangel signaliseres er derfor viktig
  - Reseptorer, transportører, kjernereseptorer etc
- Tilgang på metabolitter/osmolytter
  - Bør sees i sammenheng med endret fôringredienser (-taurin, endret AA-ratioer/ profiler)
- Eventuell “mangel på metabolitter” og funksjonaliteten av muskelen
  - Bør studeres mer systematisk og sees i sammenheng med strukturelle endringer og bløthet



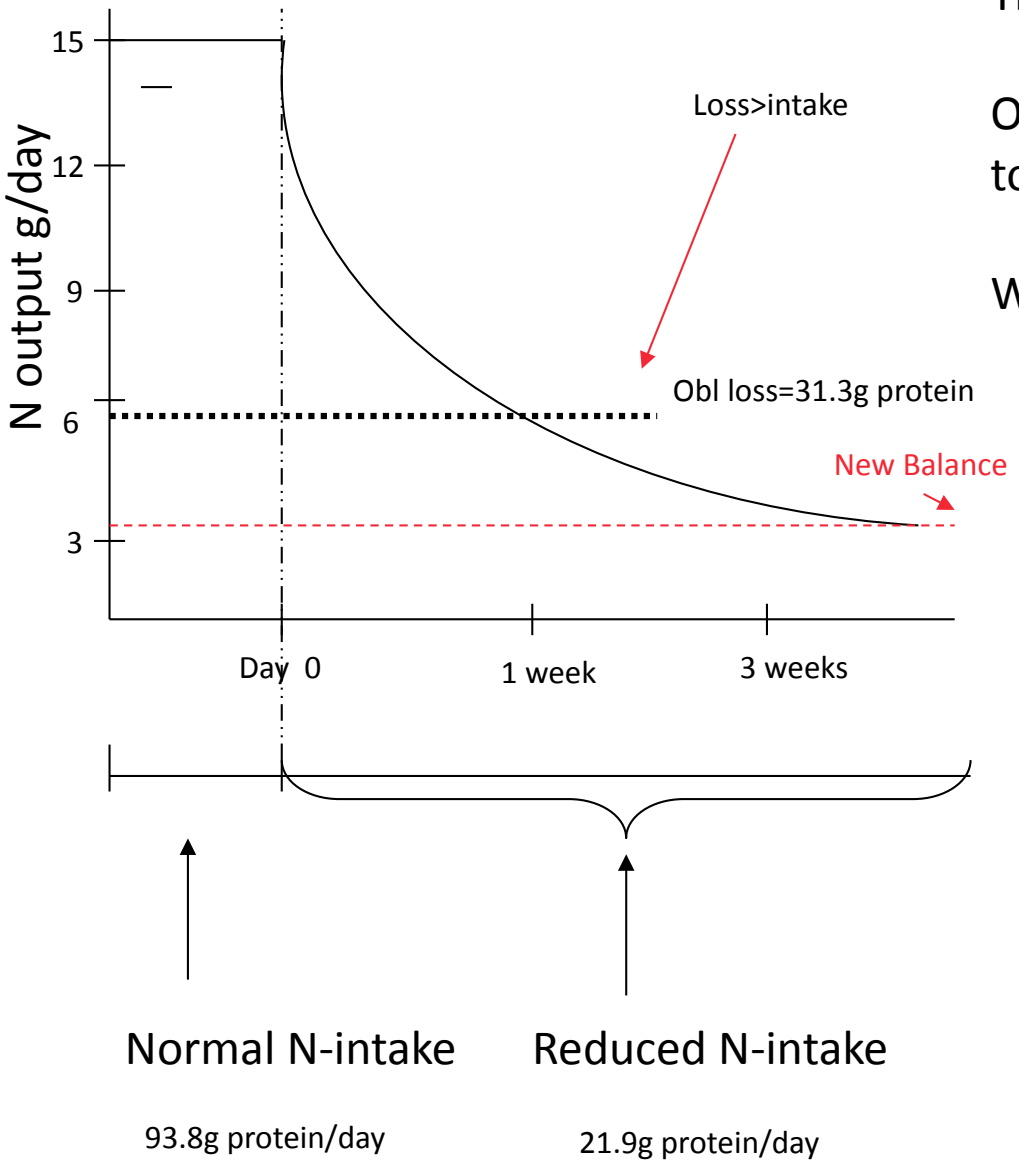

The 70 kilo man is fed 93.8g protein/daily (15g N)

On day zero his protein intake is being reduced to 31.3g protein/daily (5g N)

What will he do to adapt to this new situation?

Negative N-balance
Reduce his Urinary N output
Approximately 1 week later he has reduced
his urinary N to the obligatory loss
$U_N$=obligatory loss in a 70 kilo man is
**70mgN/kgBW/day**

70kg*70mgN=4900mgN
(4.9gN*6.25=31.3g protein)
A new N balance has been established




The 70 kilo man is fed 93.8g protein/daily

On day zero his protein intake is being reduced to 21.9g protein/daily (3.5g N)

What will he do to adapt to this new situation?

**During first week reduce the urinary loss to a minimum =31.3g protein**
**Eats less than obligatory loss, neg Bal after 1 week of**
**31.9g-21.9g= 9.4g protein**

**What will happen???**

Has to loose weight to reduce obligatory loss
70mgN/kgBW*xkg=1.504gN
Loose 21 kilo BW
BW=49kg

A new N balance has been established,
but is it an adaptation as lost 21 kilo reduced