

Realities of the feed options

International Seminar on Land-Based Aquaculture Systems

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Global fish consumption is 19.2 kg per capita

3 billion people get 20% of total protein intake

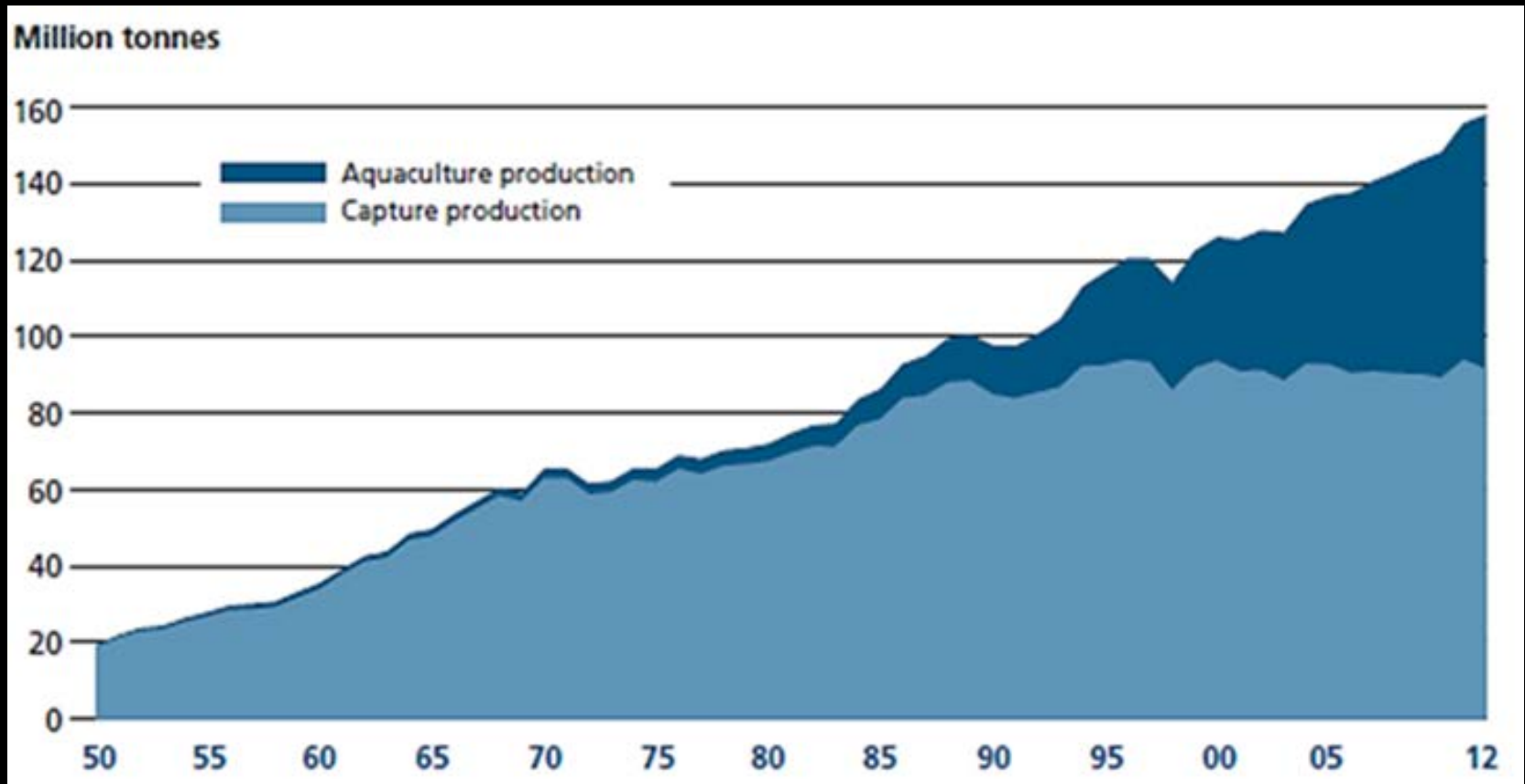
Another 1.3 billion people get 15% of total protein intake



2015= 7.2 billion



2050 = 9.6 billion



Key factors towards a sustainable aquaculture industry

Species



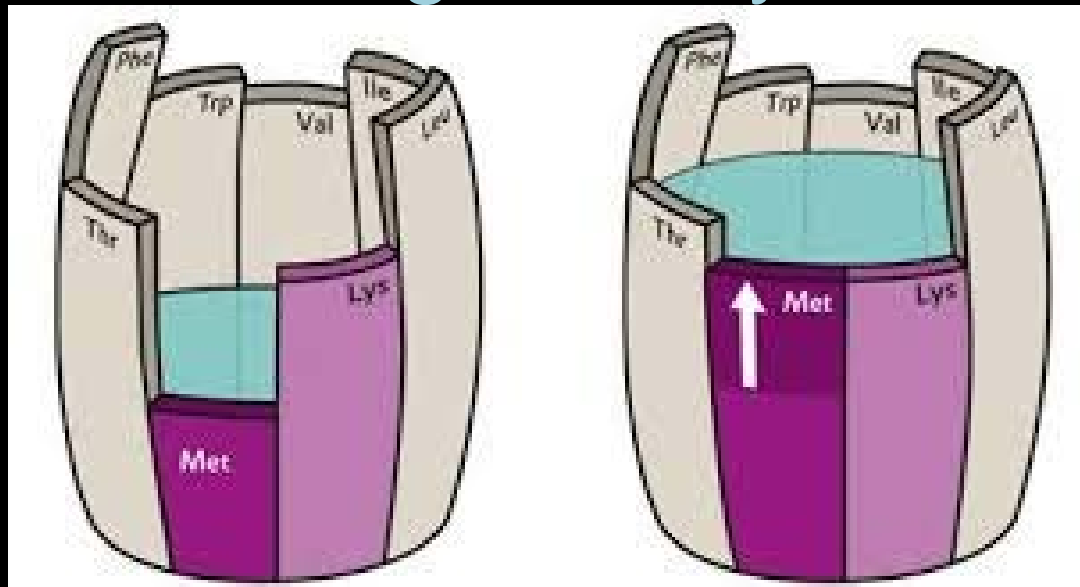
Production systems

Feed

Important parameters in a novel feed ingredient?

Nutrient composition

Digestibility



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Legislation?

Market demand?

Formula 2005

50 g other ingredient

40 g premix

40 g wheat gluten

70 g plant oil

100 g wheat flour

150 g fish oil

200 g plant protein

350 g fish meal

Formula 2015

50 g other ingredient

40 g premix

40 g wheat gluten

100 g plant oil

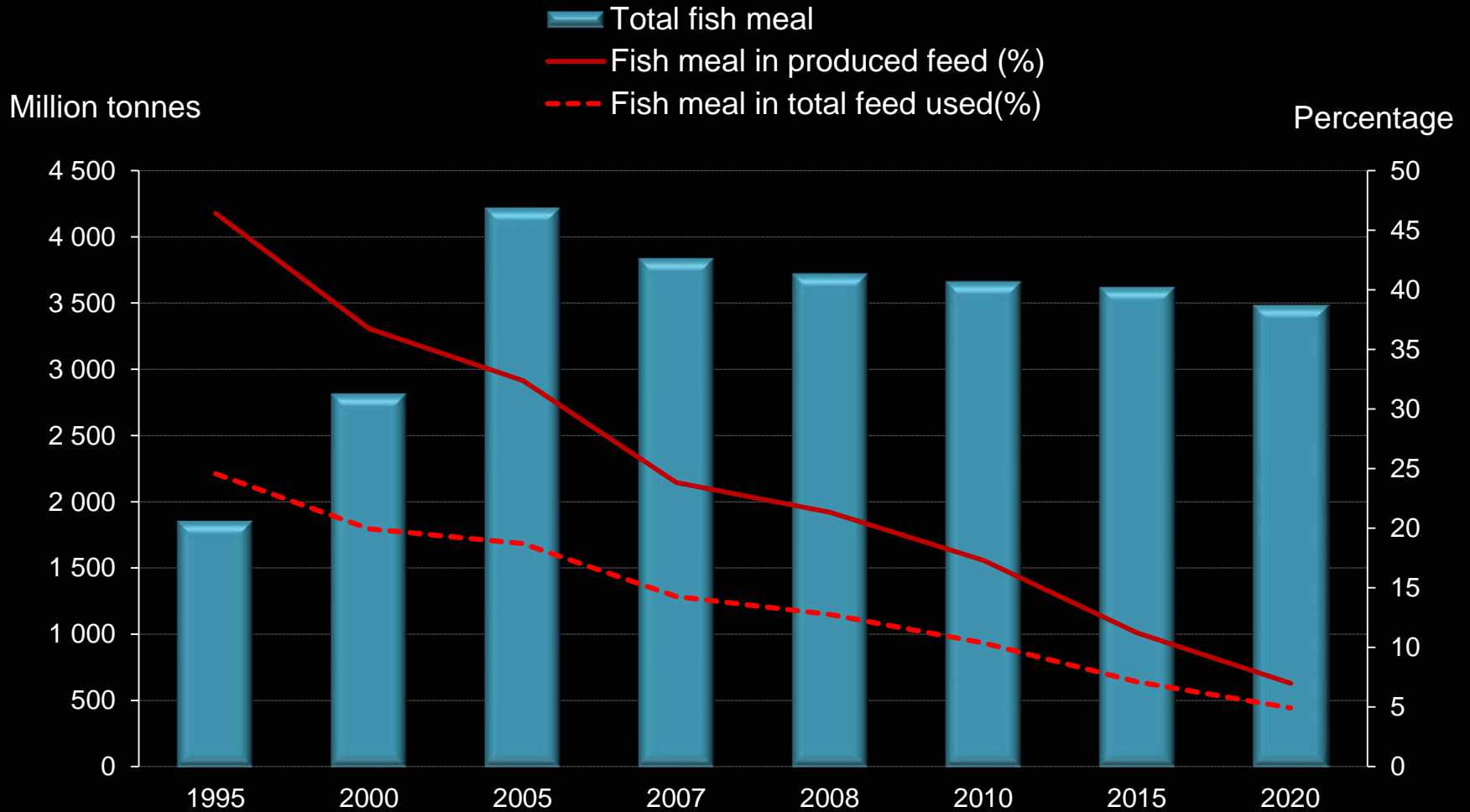
100 g wheat flour

120 g fish oil

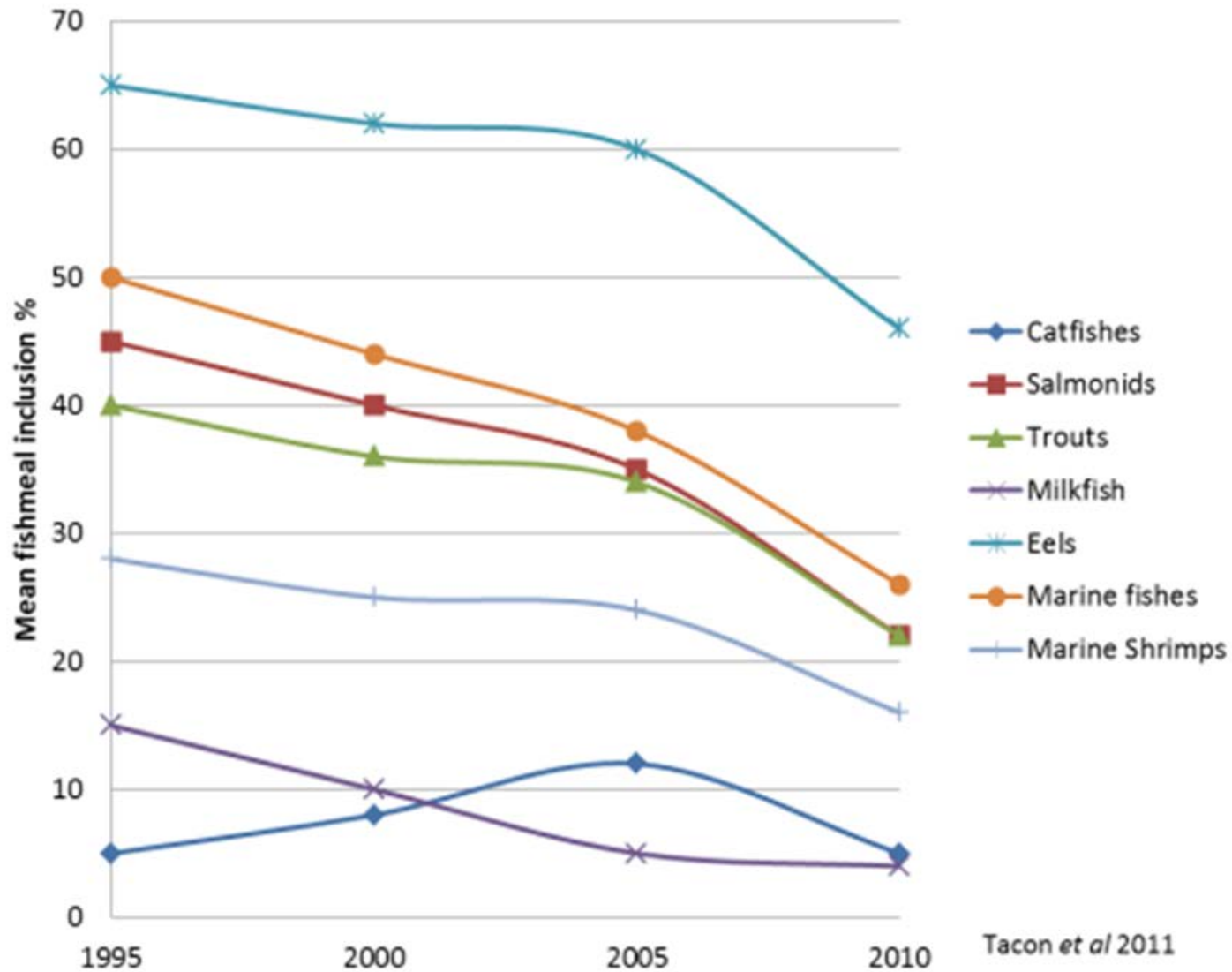
370 g plant protein

180 g fish meal

Global use of fish meal in aquaculture



Estimated Fishmeal inclusion rate in aquaculture diets 1995-2010



Alternative protein sources

Majority of alternative protein sources available today are plant based.
Several challenges:

- Chemical composition
- Digestibility
- Antinutritional compounds (enzyme inhibitors, saponins, lectins, allergens etc)
- Palatability



Compete with the human food base and future food security?

Microbial nutrient sources

No competition with human food sources

High biomass production potential

Able to grow and utilize different substrates

In general a high protein content a good amino acid profile

Thick cell walls!

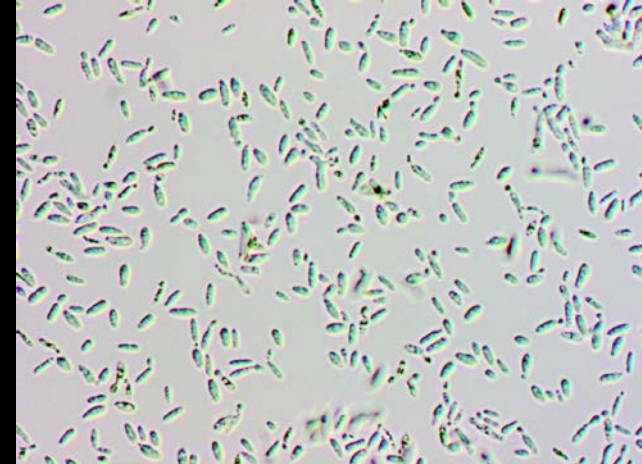
Protein source (*S. cerevisiae*)

Lipid source (*Yarrowia lipolytica*)

Pigment source (*Phaffia rhodozyma*)

Prebiotic (phytase activity)

Immunostimulant (β -glucans)



Use waste substrates

Sulphite liquor (*Zygomycetes spp.*)

Compost

Beer industry by-products

Molluscs - Blue mussel

High protein content and amino acid quality

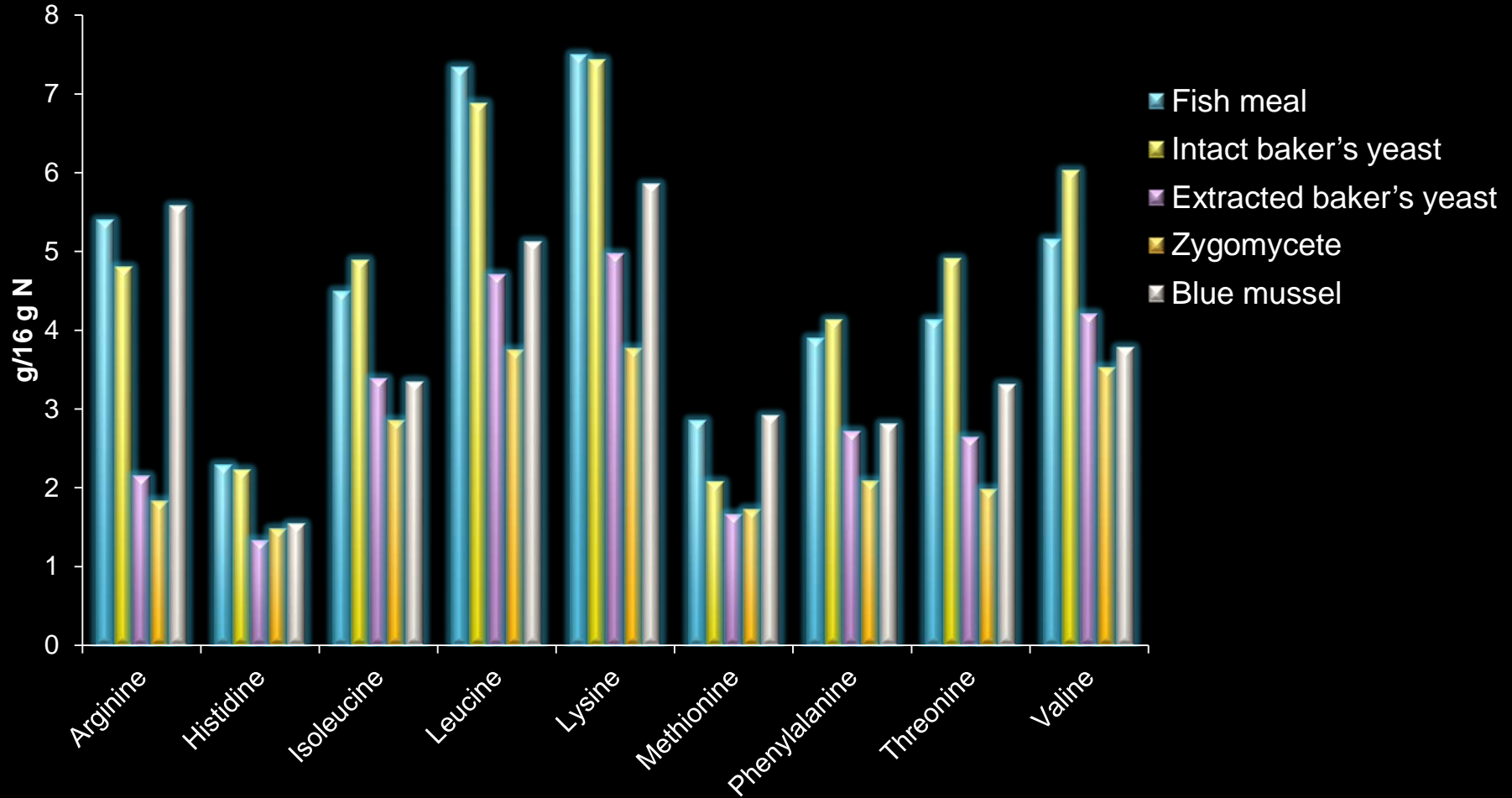
Filter feeders and thereby improve water quality by absorb nutrients

May also absorb pollutants!

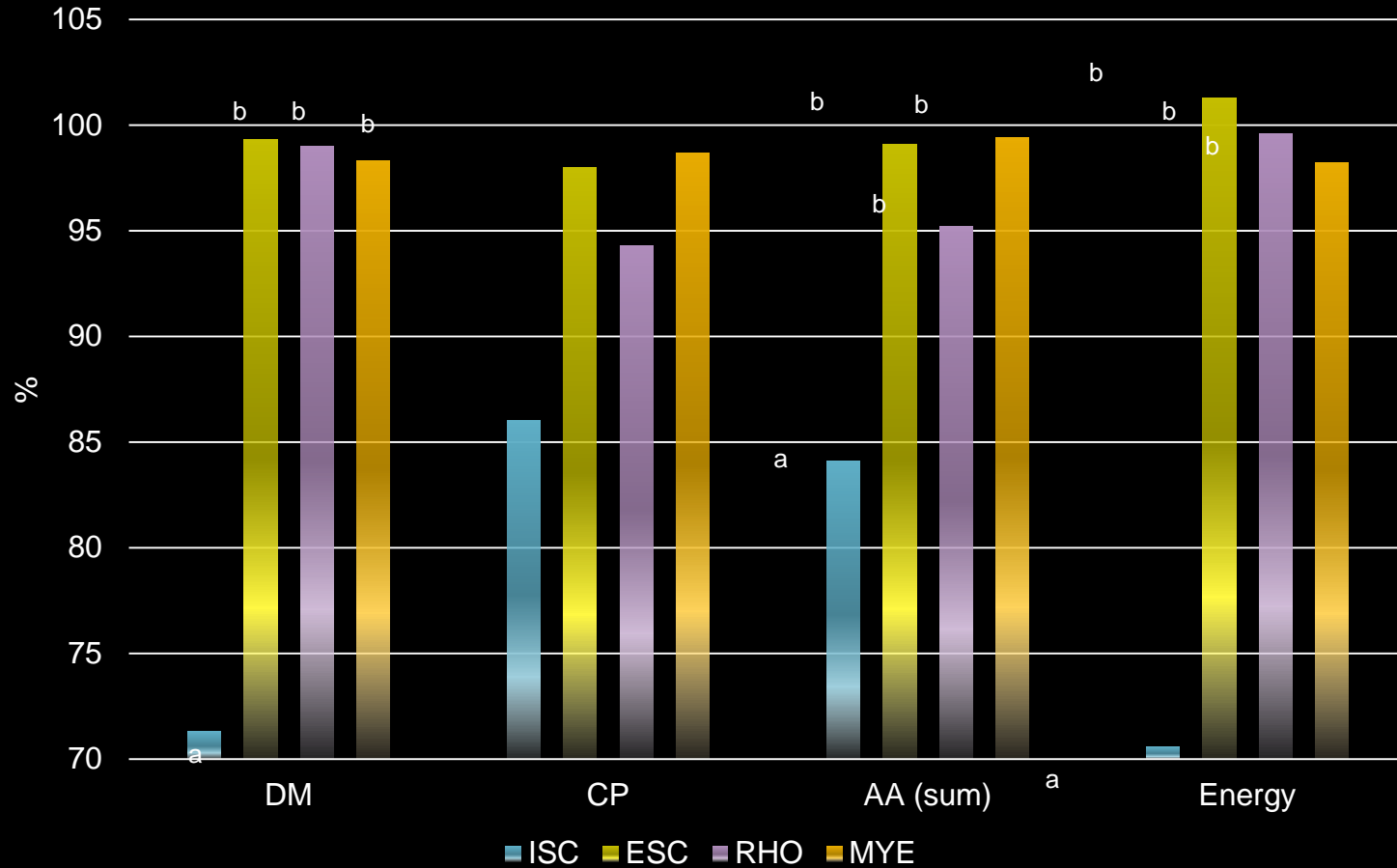
Average composition of the main groups of SCP (% DM)

Composition	Fungi	Algae	Yeast	Bacteria
True Proteins	30-45	40-60	45-55	50-65
Nucleic acid	7-10	3-8	6-12	8-12
Total N	37-55	43-68	51-67	58-77
Lipids	2-8	7-20	5-10	3-7
Ash	9-14	8-10	5-10	3-7

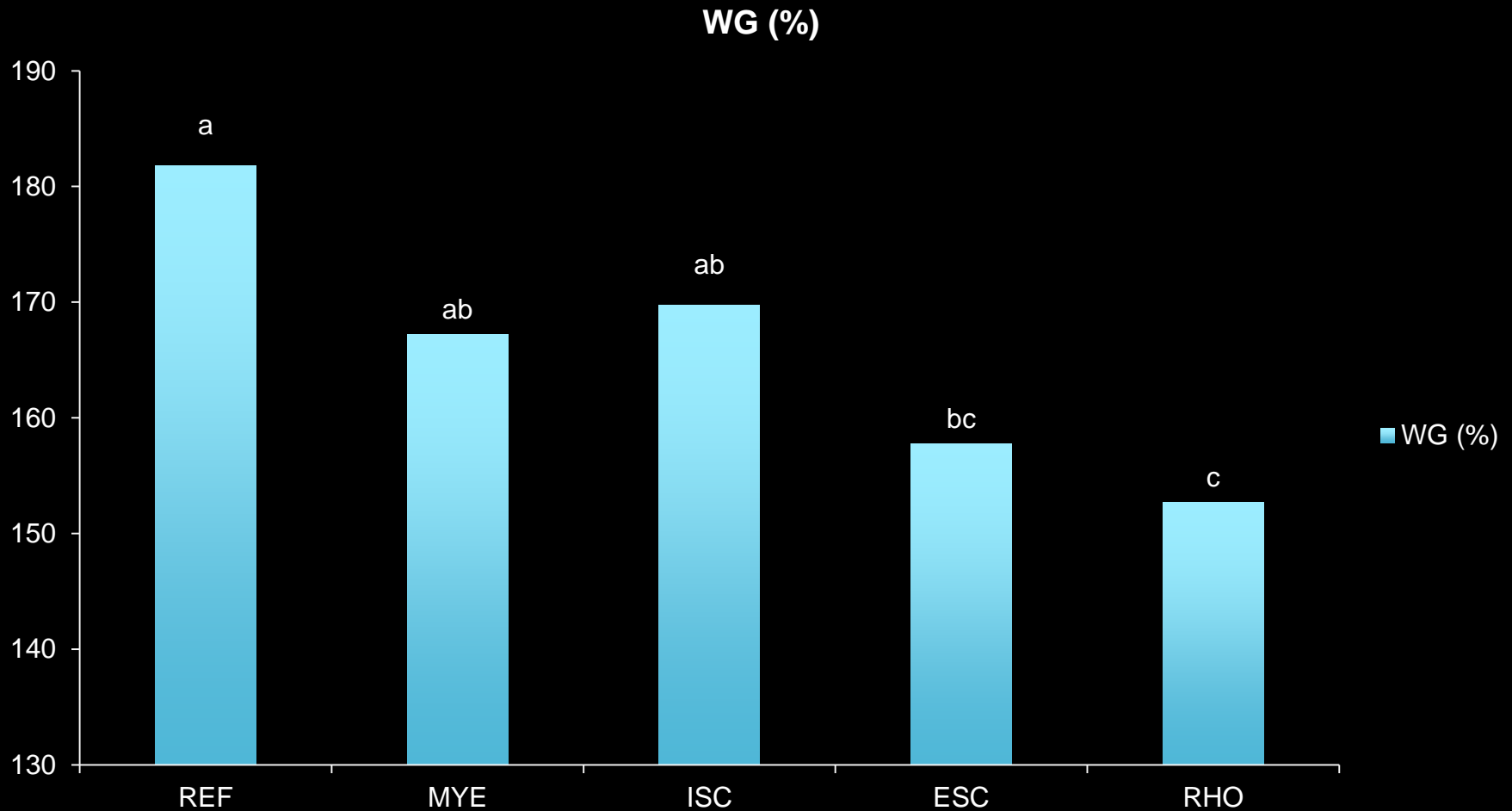
Amino acid composition (% crude protein)



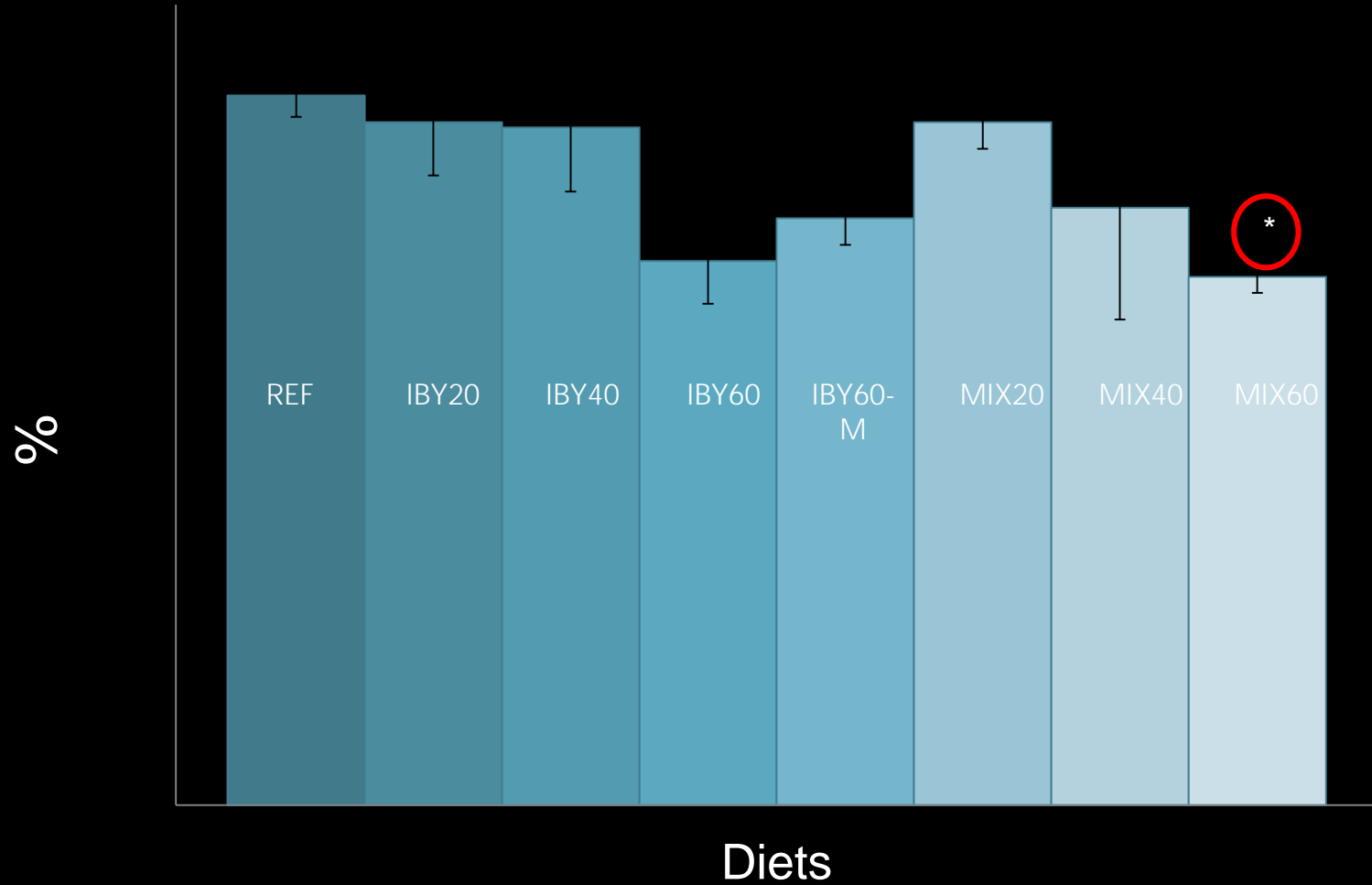
Apparent digestibility coefficient in test ingrediens for Arctic charr



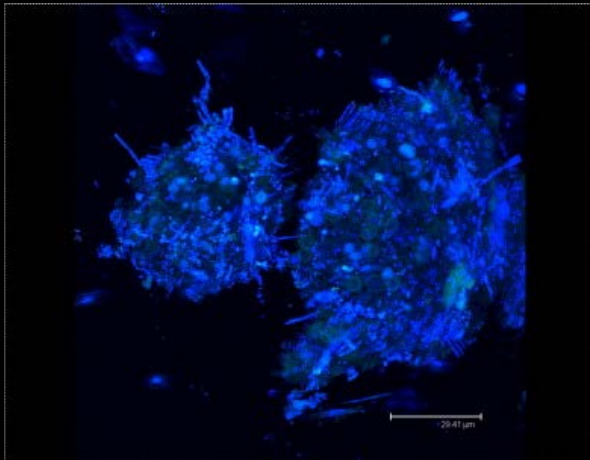
Growth performance for Arctic charr



Specific growth rate in rainbow trout



Biofloc – another approach



Insects

Black soldier fly (*Hermetia illucens*)

Nutritional value

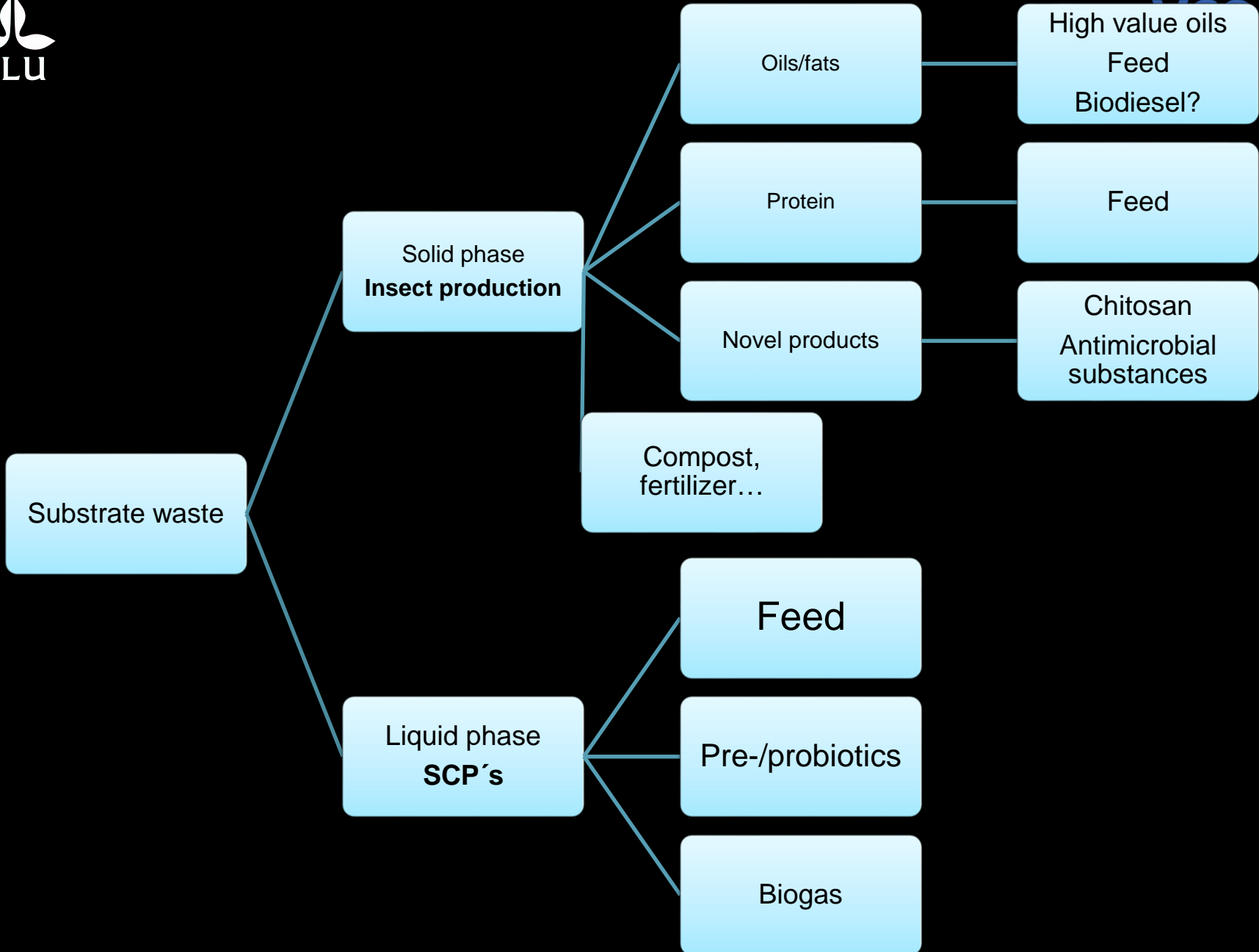
DM: 55-65%

CP: 40-45%

Lipids: 15-50%

Rich in Ca & P

Ash: 11-28%



Results on BSF fed to Rainbow trout

Up to 50% FM substitution (40% inclusion)

- No differences in growth
- No differences for somatic indexes
- No differences in fillet quality parameters
- Increase in DM and lipid content

Up to 25% FM substitution (40% inclusion)

- Good fillet fatty acid profile
- No differences for AA, EPA, DHA, n3 and n6/n3



**Thanks for
listening!**