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NTNU
Norwegian University of Science and Technology

Challenges related to purification of hydrolysate

Ignat T.

Norwegian University of Science and Technology

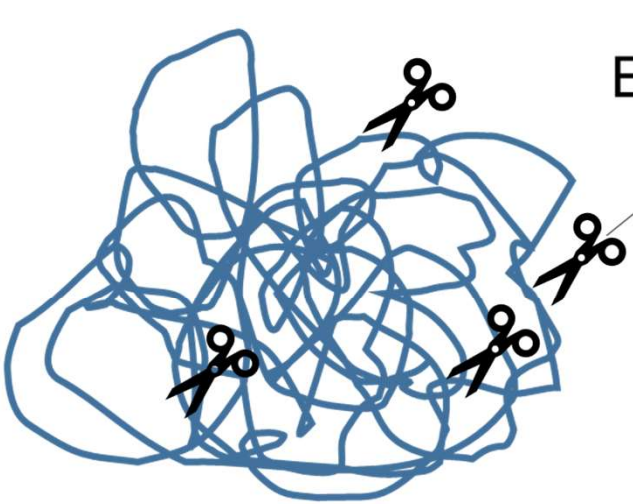
High value of RRM

Table 1 Chemical composition of by-products and whole fish for salmon and cod

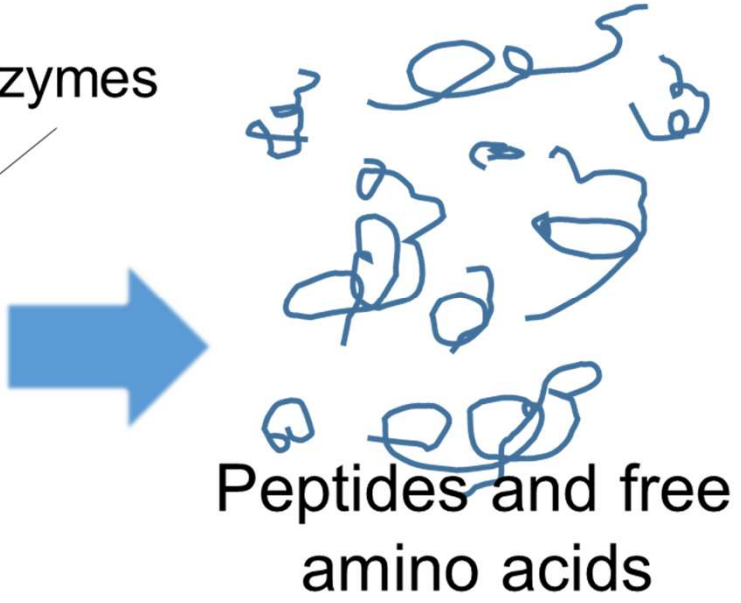
Nutrients	By-products			Whole body
	Heads	Backbones	Average	
Salmon				
Moisture	66	64.3	65.1	58.8
Lipids	16.7	15.2	16.0	21.3
Proteins	11.3	14.1	12.7	17.5
Ash	6.0	6.4	6.2	2.4
Cod				
Moisture	79.5	75.0	77.3	75.3
Lipids	0.3	0.4	0.4	5.7
Proteins	13.9	15.2	14.6	13.0
Ash	5.6	9.0	7.3	3.4

Main principle

Just fish heads



Just protein in fish heads

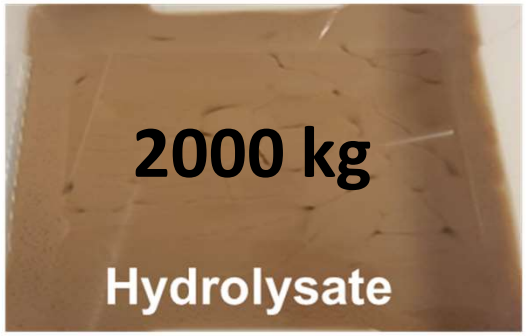


Protein based product with new properties

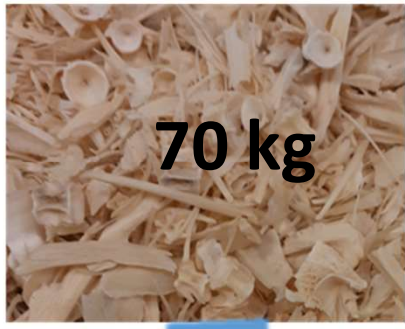
Valuable By-flows of hydrolysate: need for separation

Simultaneous efficient separation of lipids and other solids:

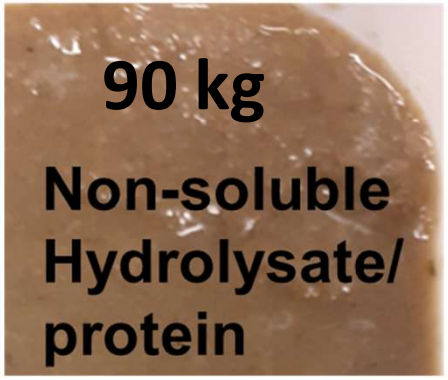
Fish oil

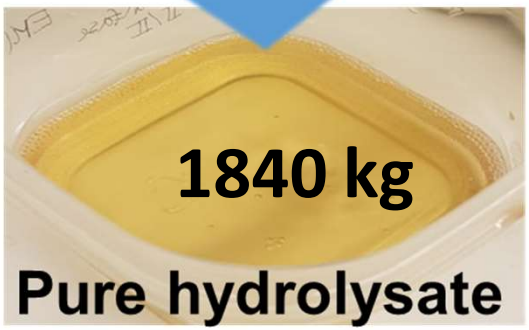


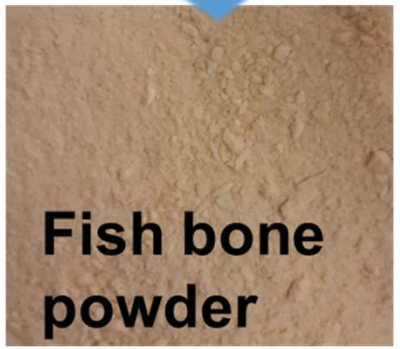
Fish bones



Separation







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Ways of hydrolysate utilization

Essential functional properties of fish protein hydrolysate:

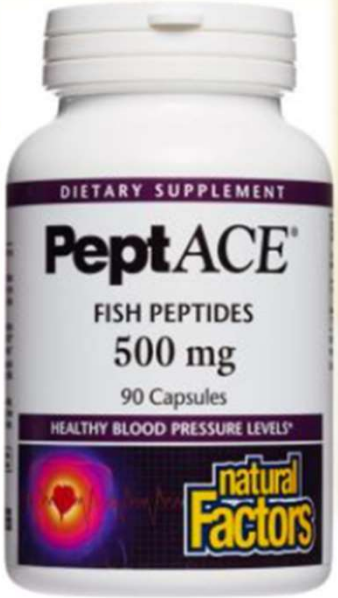
- ✓ ***New feed for fish and juveniles: increasing of weight and tolerance to deceases.***
- ✓ Substrate for microbiology

New food and bio-ingredient:

- ✓ Relatively cheap protein with high bio-value
- ✓ Protein for athletes
- ✓ Antioxidant
- ✓ Cryoprotectant
- ✓ Anti-hypertensive activities
- ✓ Stucturant (bio-glue for other protein products like fish and meat)
- ✓ Flavorant

Different degree of hydrolysis and different fractions of peptides influence the final use: separation is important

Examples:



!Just dried fish!

New sport proteins?

NUTRITIONAL INFORMATION

Nutritional Information	per 100 g
Calories	1465 / 350 kj / kcal
Fat	3,5 g
from Saturated fatty acids	1,2 g
Carbohydrates	6 g
from Sugar	3,6 g
Protein	**71 g**
Salt	0,88 g

Ratio of essential aminoacids in hydrolysate to ideal protein

	Not separated	Top layer	Bottom layer	Nano and micro-filtration
His	83.3%	74.7%	70.0%	92.0%
Thr	206.5%	204.8%	219.6%	203.0%
Met	108.2%	110.0%	110.9%	107.7%
Val	111.0%	110.0%	112.8%	107.4%
Phe	68.2%	63.4%	76.1%	63.9%
Ile	95.7%	94.0%	103.0%	94.0%
Leu	102.7%	99.5%	120.3%	99.3%
Lys	141.3%	139.8%	141.1%	141.8%

Decrease bitterness of hydrolysate?

Ways of bones utilization

Calcium from salmon and cod bone is well absorbed in young healthy men: a double-blinded randomised crossover design

Marian K Malde, Susanne Bügel, Mette Kristensen, Ketil Malde, Ingvild E Graff & Jan I Pedersen

Nutrition & Metabolism **7**, Article number: 61 (2010) | Cite this article

Proprietary Blend (700mg/capsule) **Calcium Fish Bone Powder** (MCHC), Magnesium Citrate, Vitamin K2 (MK-7), UAF1000+ Superfoods (Pine Bark Extract, Grape Seed Extract, Red Grape Skin Extract, Kiwifruit Extract, Blackcurrant Extract, Boysenberry Extract, Fulvic Acid), Vitamin D3.

Does filtration method influence on quality?

High degree of filtration

T=20 °C
P=20mbar

Low degree of filtration

Non-soluble sediments Due to low separation quality

T=20 °C
P=20mbar

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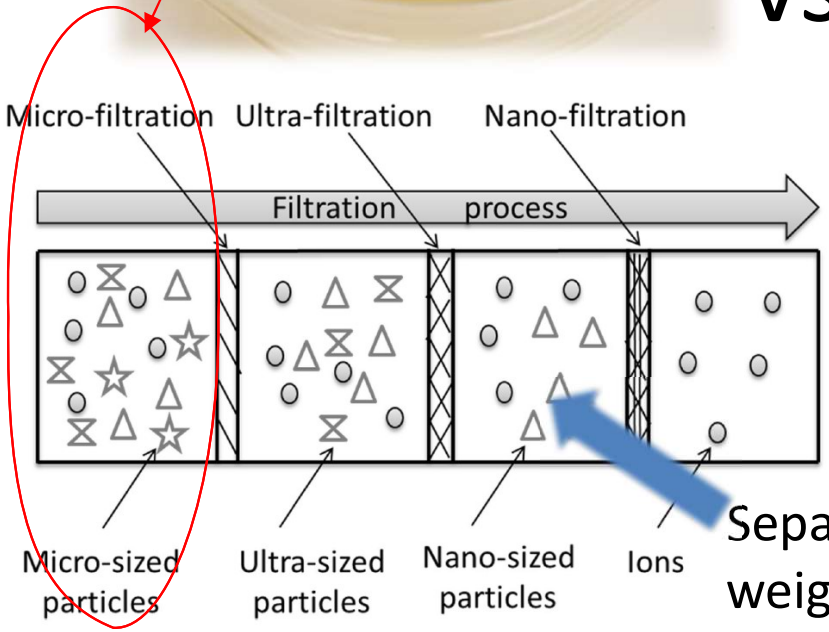
Does other processing methods influence on quality?

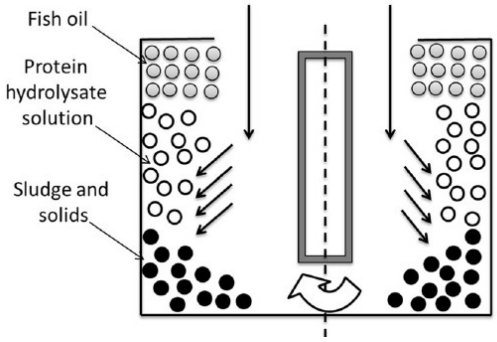
Top: Raw hydolysat vacuum freeze dried (VFD), Separated VFD, Sediments VFD, Nanofiltrated VFD
Bottom: Spray dried (sD) raw, SD separated, SD sediments, SD after vacuum concentration raw hydrolysate

Particle size and separation level influence on color characteristics
High temperature long drying influence on color - browning

Experiments with purification of hydrolysate

VS



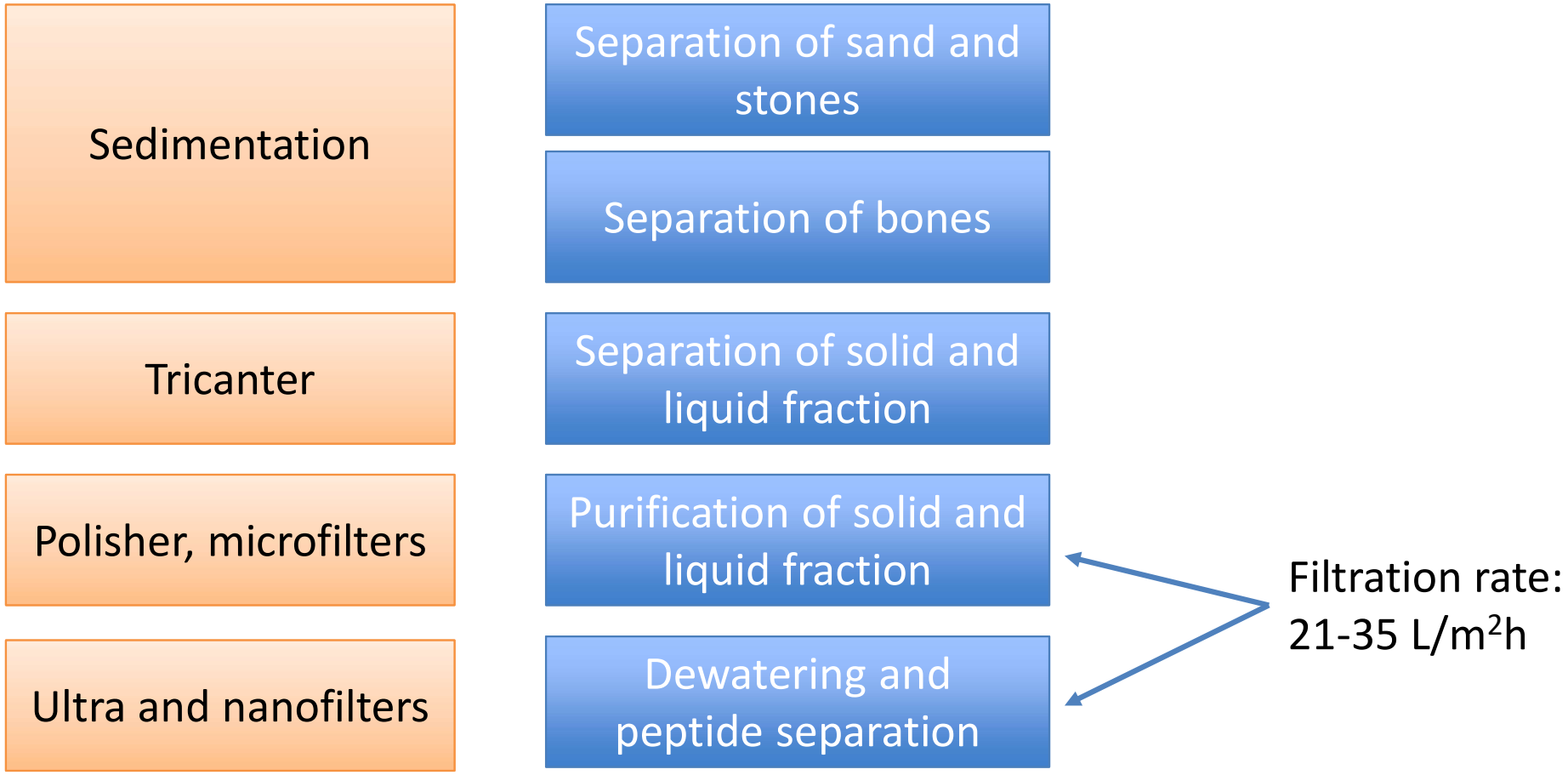


Separation by molecular weight!

Application of separation methods, cod heads hydrolysate

Sample	Solids, %	Salt , %	Protein, %
Not processed hydrolysate	7.81	0.93	6.59
Top fraction (sedimentation)	7.06	0.92	6.08
Bottom fraction (sedimentation)	9.09	0.79	7.15
White ribbon (4-12 µm)	7.10	0.65	6.39
Blue ribbon (<2 µm)	5.82	N/A	5.24
Nanofiltration (<2 nm)	20.14	**0.74**	18.71

Optimal separation procedure



Filter size over 51 m^2 for flow of rest raw material of 1000kg per h

Conclusions

- ✓ By flows of hydrolysate production are valuable and have market potential
- ✓ Separation is essential for high quality and diversification of the production
- ✓ Separation should be conducted in several steps – this is the key for high quality final product
- ✓ Nanofiltration helps to decrease salt concentration and dewater the product
- ✓ Process of micro and nanofiltration requires high area of filters

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THANK YOU FOR YOUR ATTENTION
Questions are welcome