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Control of fraudulent addition of water to octopus using a rapid and non-destructive method

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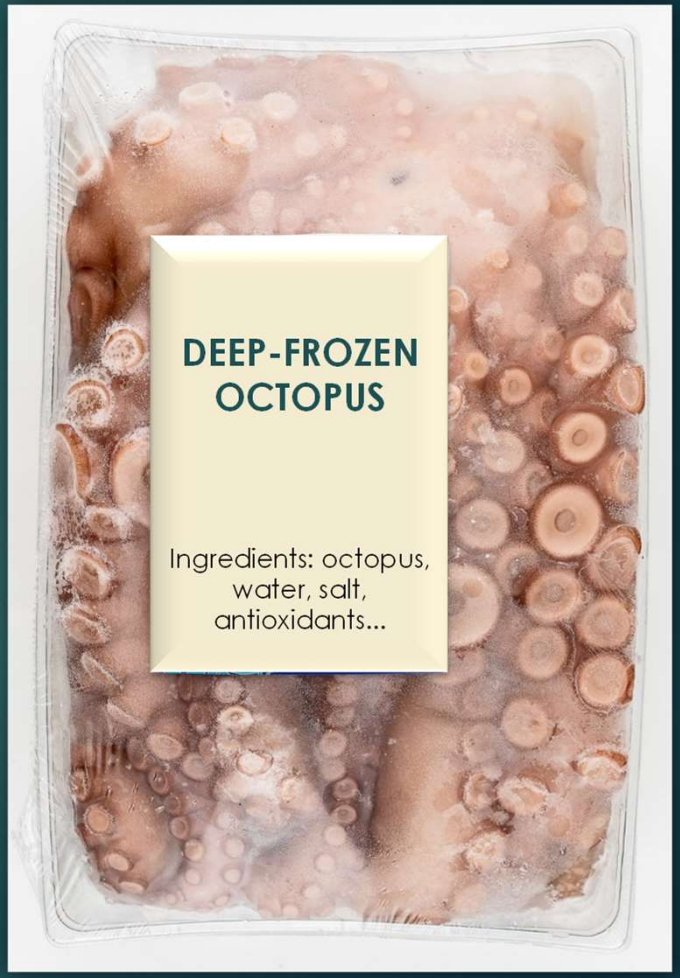
Consumption of octopus

- Common octopus (*Octopus vulgaris*) is an important fishery resource in terms of economic value, in southern European countries.
- Consumers complain for an enormous weight loss of octopus after cooking.

Regulation of water addition

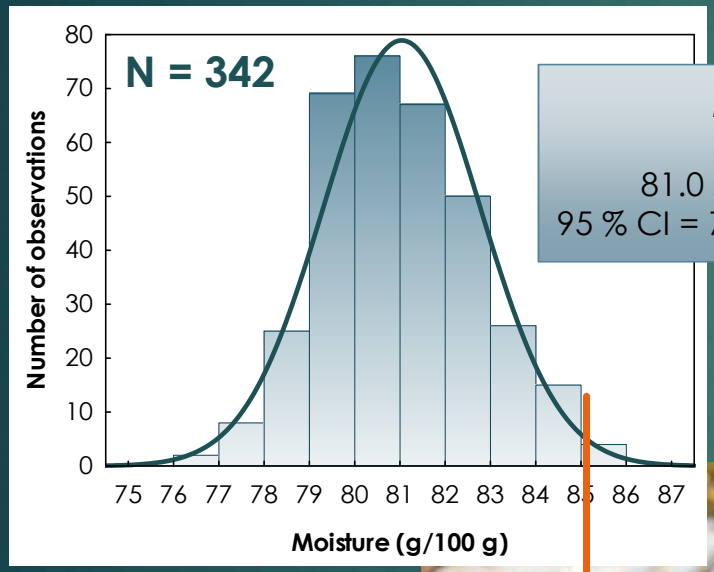
- Regulation (EU) No 1169/2001 states that "***the name of the food shall include an indication of the presence of added water if the added water makes up more than 5% of the weight of the finished product***".

- Water addition to seafood is regulated, but there are some challenges regarding the control of the legislated values.



Moisture content & Cooking losses

Common octopus *Octopus vulgaris* from the Portuguese coast

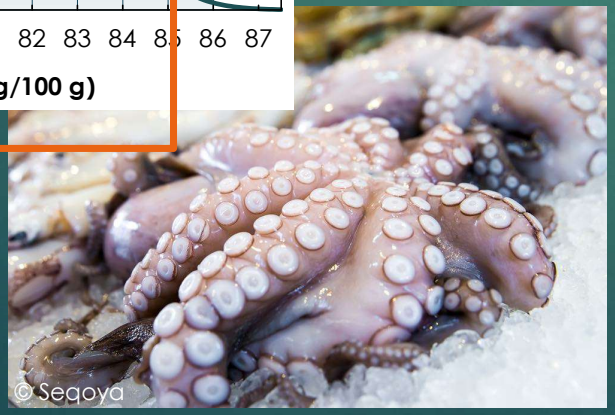


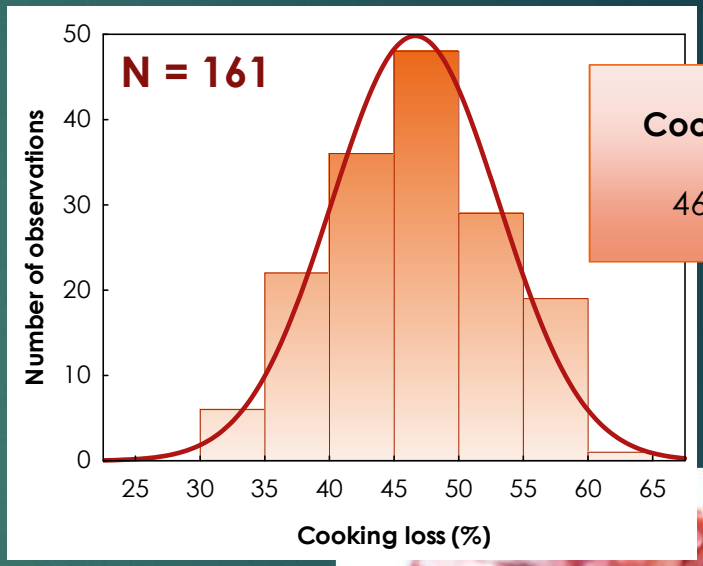
Moisture

81.0 ± 1.7 g/100 g
95 % CI = 77.6 – 84.4 g/100 g

85.2 g/100 g

Limit level of moisture for conformity assessment





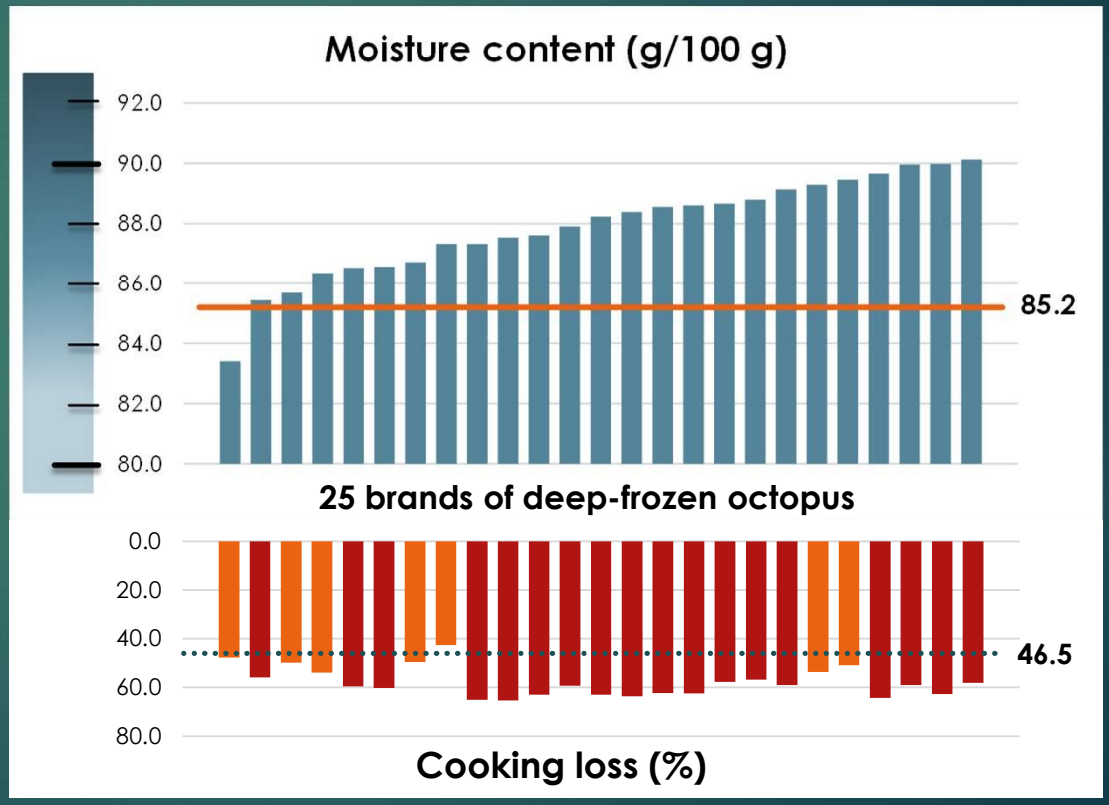
Cooking losses

46.5 ± 6.4 %

Commercial deep-frozen octopus

Octopus from the Portuguese market

18 brands of deep-frozen octopus with cooking losses higher than 55 %



Limit level of moisture for conformity assessment

Rapid and non-destructive method

SEQUID

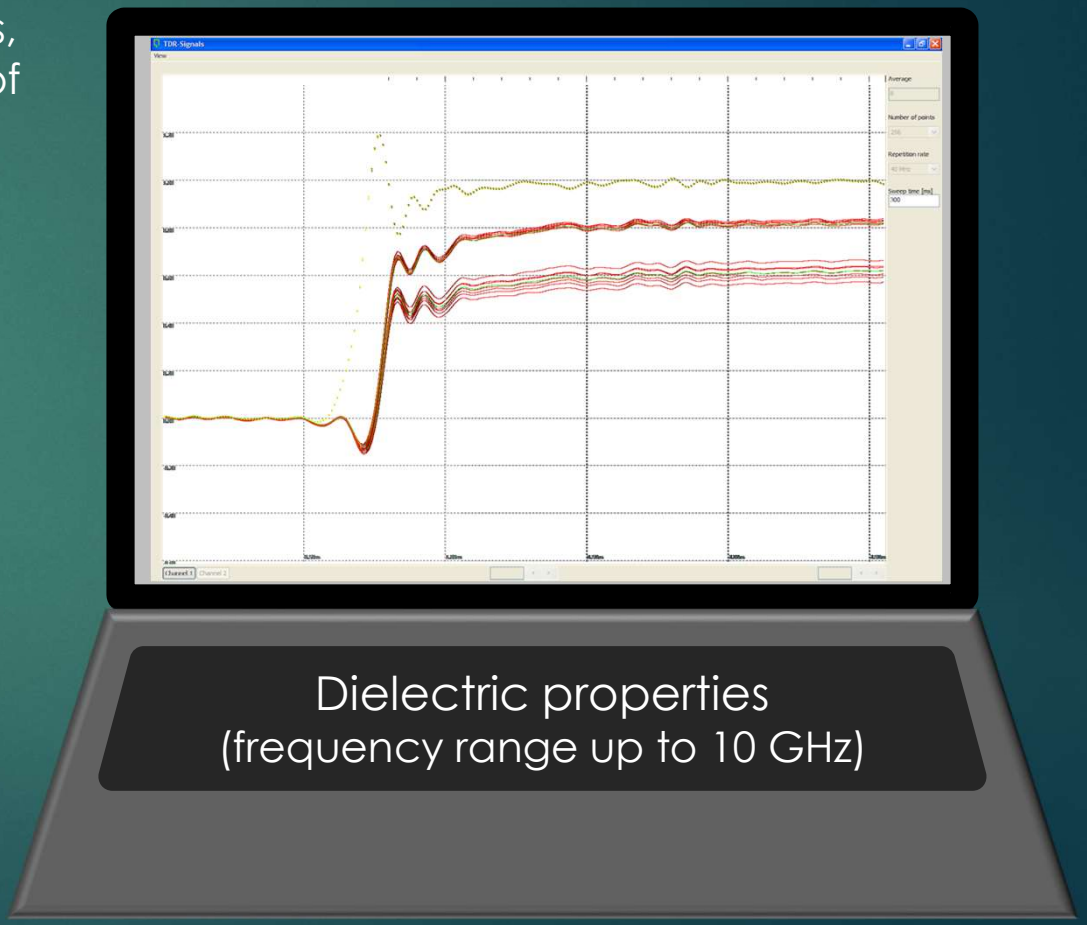
Bremen, Germany

RFQ-Scan® is based on the principle of dielectric spectroscopy

measuring area

Time domain reflectometry (TDR)

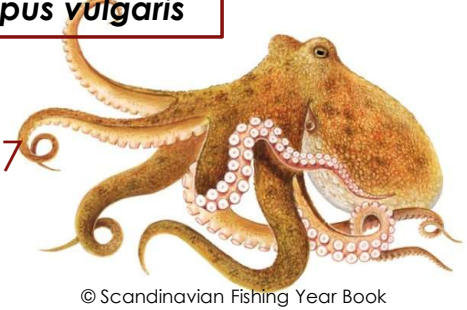
A method based in TDR analysis was developed for the control of abusive water addition to octopus, not only for detection, but also for quantitation of water content in water-added octopus.



Dielectric properties
(frequency range up to 10 GHz)

Water addition trials

common octopus
Octopus vulgaris



N = 77

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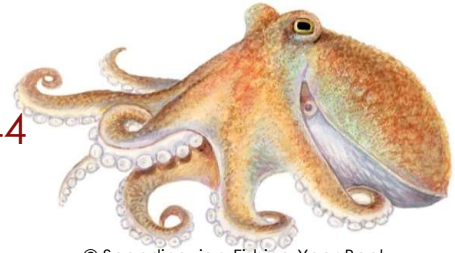
curled octopus
Eledone cirrhosa



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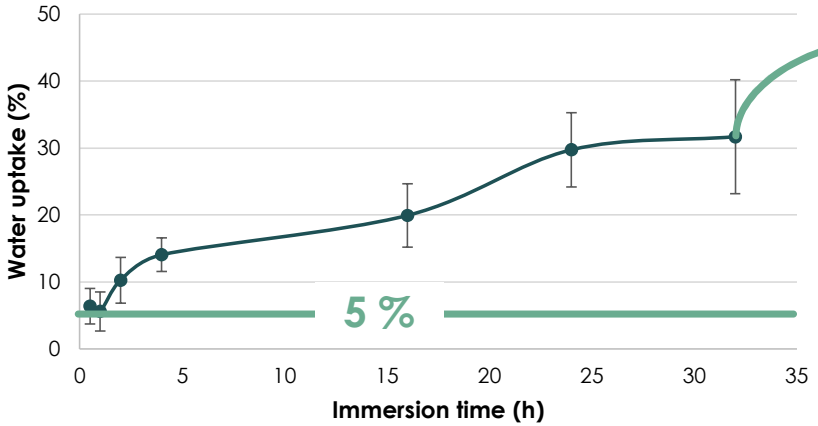
Time Domain Reflectometry analysis

ca. 500 measurements

Water uptake in octopus

Octopus vulgaris

Common octopus *Octopus vulgaris*



water uptake
31.7 %

1.000 kg
€ 10.00
cooking loss
46.5 %
0.535 kg

1.317 kg
€ 13.17
cooking loss
65.1 %
0.460 kg

32 h

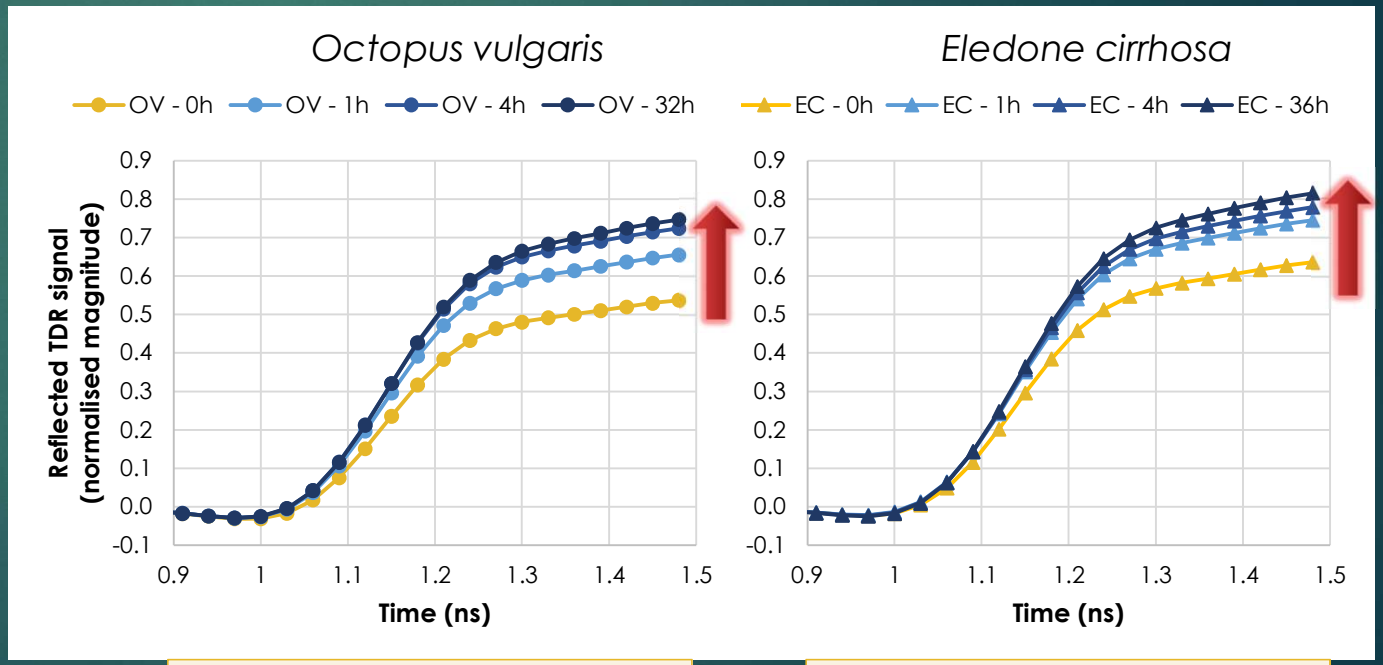
Octopus increased in weight about 5 % in short immersion treatments (0.5 – 1 h)

TDR – Common octopus vs Curled octopus

In the region 1.2-1.5 ns, the reflected TDR signal increased with the increase in immersion time.

TDR results were different between the two octopus species.

Control samples of *E. cirrhosa* showed higher TDR values than *O. vulgaris*



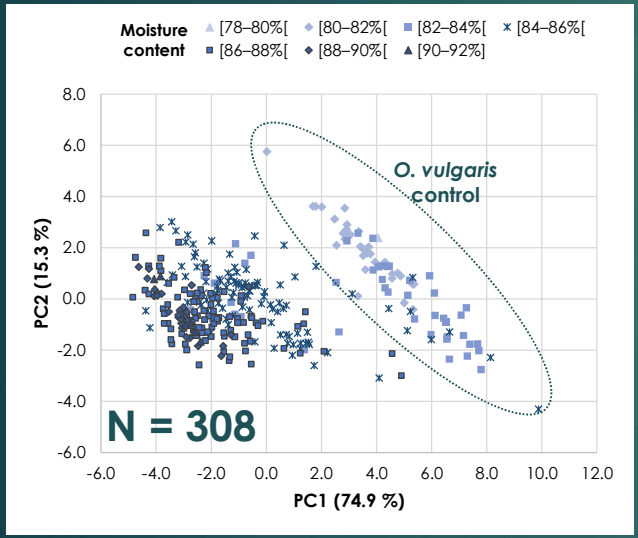
Moisture = 82.3 g/100 g

Moisture = 78.9 g/100 g

Quantitation of moisture using TDR

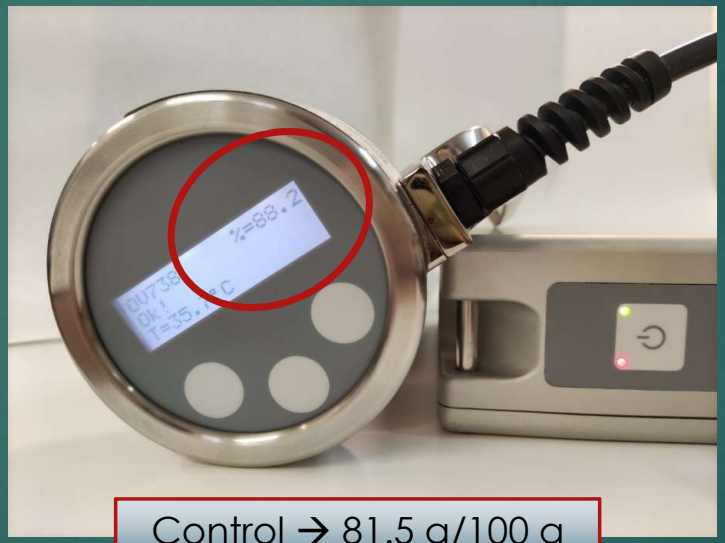
Octopus vulgaris

MULTIVARIATE ANALYSIS



Principal components analysis
Multiple linear regression
RMSE = 1.1 %
R^2 = 0.784

MOISTURE QUANTITATION



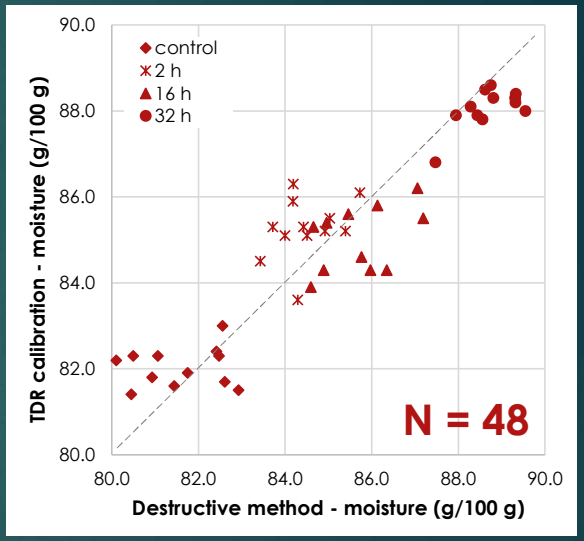
Control → 81.5 g/100 g

2 h → 85.2 g/100 g

16 h → 86.2 g/100 g

32 h → 88.2 g/100 g

VALIDATION RESULTS

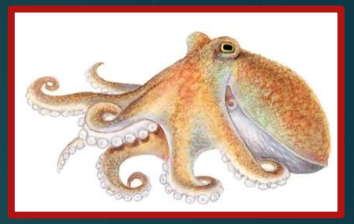


New trial with *O. vulgaris*

RMSE = 1.0 %
R^2 = 0.796

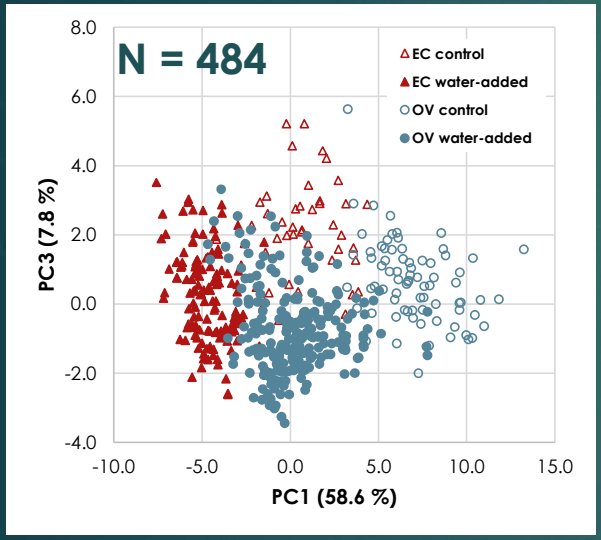
Detection of water addition

Octopus vulgaris



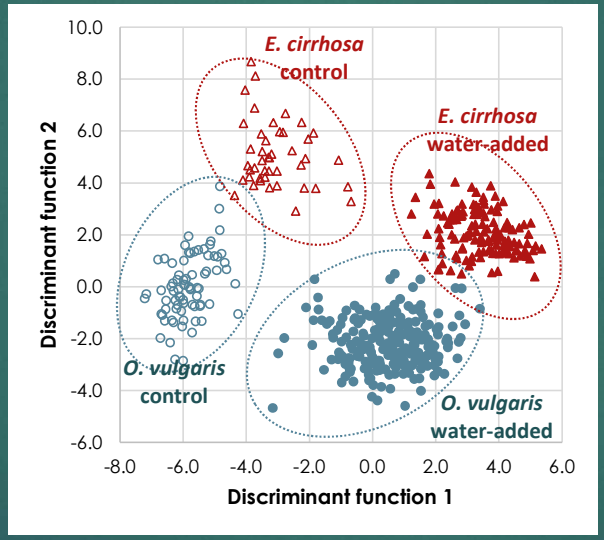
Eledone cirrhosa

MULTIVARIATE ANALYSIS



Principal components analysis

CLASSIFICATION MODEL



Linear discriminant analysis
4 groups

VALIDATION

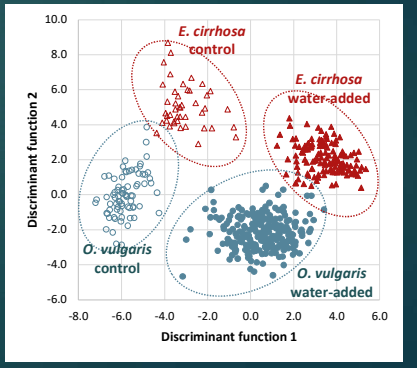
		PREDICTED GROUPS MEMBERSHIP			
		O. vulgaris control	*O. vulgaris* water-added	*E. cirrhosa* control	*E. cirrhosa* water-added
ACTUAL GROUPS	*O. vulgaris* control	**74 (97.4 %)**	0	2 (2.6 %)	0
	O. vulgaris water added	1 (0.4 %)	**226 (97.8 %)**	0	4 (1.7 %)
	E. cirrhosa control	0	0	**44 (100.0 %)**	0
	E. cirrhosa water-added	0	0	0	**132 (100.0 %)**

Cross-validation (5-fold)

98.6 % of the samples were correctly classified

Conclusions

- Rapid and non-destructive method calibrated and validated for quantitation of moisture content in common octopus (*O. vulgaris*).
- TDR data combined with linear discriminant analysis can be used for the detection of water addition independently of the species (*O. vulgaris and E. cirrhosa*).
- The methods developed can be used by the industry and quality control inspections for assessment of octopus quality and to verify compliance with legislation, promoting fair trade practices, and further contributing to a sustainable use of resources.



Acknowledgements

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