ADDED WATER IN FROZEN SCALLOP MUSCLES
FRENCH SPECIFICATIONS AND METHODOLOGY

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H. LOREAL and M. ETIENNE - IFREMER NANTES

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The problem of foreign or added water is not really specific of scallop muscles. Nevertheless, the astonishing ability of scallop muscle to soak up water makes the problem keen.

Heavy water additions that bring about excessive loss of water when thawing scallops are clearly a falsification.

Frequent abuses have been established in France in the 1980-1986 years, so much so that the product might depreciate in the eyes of the consumers.

Consequently French importers and administrations decided to elaborate a standard in order to eliminate excessively soaked scallops and to preserve the brand image of the product.

Three points are defined in this standard :

. a sampling plan (codex plan NQA 6,5 S3)

. the water/protein ratio on deglazed scallop muscles as analytical method.

. a limit value set at 5,0 as criterion of conformity.

After short spots about trade and regulation, we shall examine the methodology used in France to check the conformity of scallop muscles and the datas collected in Ifremer laboratories. We shall try to answer two questions :

- Are H/P values well correlated with added water ?
- Is 5 a fair limit-value of H/P ?

Trade information

Importations of scallops represent a little part of French importations of fish products in weight. Regarding the value, this part is very important.

According to recent official statistics, France imports 9 500 T of different species of scallops. The total value is 507 MF (about 90 M $). The price range is 13,5 to 84,5 F/kg and the mean price is 55 F/Kg.

1700 T are imported alive or chilled. Remaining 7800 T are imported frozen.

Japan is the first exporter with 3200 T of *Patinopecten yessoensis*. Other main exporters are United Kingdom and Nordic countries which produce king scallops *(Pecten maximus)* and queen scallops *(Chlamys varia* and *Chlamys islandicus)*. Little quantities come from New Zealand and Australia, Chili *(Argopecten purpuratus)* and Canada (*Placopecten magellanicus)*.

Regulation information

Like any other food, scallops must be consistent with hygienic, essential composition and quality factors, and labelling requirements of the general regulation.

There is no specific international standard (such as Codex Standards) for scallops.

French specifications concerning scallops are in correspondence with general regulations.

Beside hygienic quality, the fairness of frozen scallop is checked with respect to two criteria :

. conformity with labeled frozen net weight ; as say several Codex standards : "where products have been glazed, the declaration of the net contents of the product shall be exclusive of the glaze".

. no added water is allowed.

This means no added water but for water which enter the shellfish flesh during the indispensable washing operation. Consequently, a tolerance has to be defined.

This tolerance may be based upon EC regulation. As says directive 79/112/CEE concerning labelling of prepacked foods : "added water is declared in the ingredient list... The amount (of added water) may be not taken in account if, by weight, it does not exceed 5 % of the final product" (item 6.5. a). To be sure, water is not really added and used as an ingredient in the process of preparation of scallops ; nevertheless when uptakes come up to 10 % , 20 % or more, water is actually an ingredient. So, where it is not declared, it should not be present.

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Review of methods

Three years ago, determination of thaw-drip was used by French laboratories for checking frozen scallop conformity. However there is a poor correlation between the amount of added water and thaw-drip.

Importers asked IFREMER to test different methods in order to select a more accurate method.

Tested methods were :

- determination of thaw-drip in a chilled room regulated at 4°C,
- determination of total water
- determination of total nitrogen
- determination of the "Feder Number"

Nitrogen content and Feder Number give the most accurate results. Finally the water/protein ratio which is closely equivalent to FN was selected.

The principle of the standard consists in determining water/protein limit ratio which takes in account a 5 % uptake of not avoidable water by washing operations, and the biological variations.

Then two questions arise :

- what is the FN of scallops ?
- how much does increase water/protein ratio when 5 % water is added ?

1 - FN of scallops.

More precisely the problem is to determine the range which FN varies within a species of scallop. Moreover, are FN values of several species signicatively different ?

The only way to determine a true FN value is to analyse alive scallops.

Table1 shows the composition and the water/protein ratio of different species of scallops analysed alive.

IFREMER analysis were made in 1990 on muscles removed from alive scallops ; muscles were washed under tap freshwater then drained 5 mn on a sieve before immediate analysis. Moisture and total nitrogen determinations were performed in compliance with AFNOR analytical methods.

Small differences are observed between the H/P values of *Pecten maximum* analysed at IFREMER, *Patinopecten yessoensis* analysed by Japan Frozen Food Inspection Association, and *Argopecten purpuratus* analysed by D.G.C.C.R.F. Laboratory at Massy (France).

Is FN modified according to freshness of the shellfish ?

Analysis were performed on scallops stored in a chilled room at 4° C. Muscles were removed from shells after 2 days and 5 days and processed as described on the transparent.

Other scallops of the same batch were shelled out on the D day, put in plastic bags and stored in ice.

Results are shown in table 3

Scallops stored (in shell) in a chilled room were all died after 5 days, (in fact 7 days after catching); nevertheless, muscles were not spoilt and remained edible. Composition slightly varies in such a way that water/protein ratio is decreasing from 4,5 to 4,2 due to losses of water during the storage.

Muscles removed from alive scallops on the D day and stored in ice are very stable. No spoilt odour or flavour occur after 7 days. Composition and consequently water/protein ratio does not change significatwely.

2. - Influence of soaking on water/protein ratio.

Two studies were carried out in 1987/1988 and 1990 at Ifremer Laboratory with *Pecten maximus.*

In the two studies muscles removed from alive scallops have been washed under tap fresh water, weighed after 5 mn draining, then soaked, excepted for reference sample, in chilled fresh water in a tray (water/scallop muscles ratio = 6/1) during 15 mn, 1 H and overnight in the first study, during 15 mn and 30 mn in the second study. Scallops muscles were allowed to drain 5 mn on a sieve, then reweighed.

In the first study muscles were frozen in a horizontal plate freezer. The frozen net weight was determined, then muscles were glazed by rapid soaking in chilled water ; frozen glazed muscles weight was measured, then samples were stored in plastic bags in freezing store at - 26°C.

In the second study a part of soaked drained muscles were taken off for immediate analysis. Remaining muscles were frozen in a cryogenic cell (CO2), then processed as previously.

Results are shown in table 4 ; samples are coded as followed:

. F. analysis on fresh muscles.

. 0, 2, 5... days of storage before processing scallops.

. 15,30 .... soaking during 15 mn, 30 mn.

. C d .... analysis on deglazed frozen muscles.

. C g .... analysis on glazed frozen muscles.

. A .... 1987 study, unsoaked sample.

. B ..... 1987 study, 15 mn soaked.

. C ..... " " 1 H soaked

. D ..... " " overnight soaked.

Amount of glazing was determined by immersing sample in a tank of water at 20°C $\pm$ 5°C (water/sample ratio = 10/1). Until all ice that can be felt is removed (20 - 30 sec.). Adhering water is removed by the use of a paper towel, then the product is weighted.

From the H/P values, amounts of added water were calculated for comparison with added water amouts determined by weighing.

H/P values are plotted against added water amounts on the figure 1.

The regression line gives H /P (or FN) = 4,41 and the slope is 0,076. Correlation coefficient r = 0,948. A 5 % water adding corresponds to H/P = 4,76.

Conclusion

The 1990 study is not finished. Nevertheless considering the checked datas in our possession, we can notice that FN of scallops varies from 3,9 to 4,6. French requirements are based upon a H/P limit value such as H/P $<$ 5. In our opinion, this limit takes in account the uptake of not avoidable water by normal washing procédures.

TABLEAU 1 - COMPOSITION DES PECTINIDES - PROXIMATE COMPOSITION OF SCALLOPS (g p.100g.)

Noix sans corail fraîches obtenues à partir de coquillages vivants

Fresh muscles without roes, from alive scallops

Espèce - Species Substance	Origine	Humidité Moisture	Protéïnes Proteins (N x 6,25)	Glucides Carbohydr.	Lipides Fat	Cendres Ash	H/P	H + P
Patinopecten yessoensis (J.F.F.I.A.)	JAPON	77,6	18,4				4,21	96,0
Argopecten purpuratus (D.G.C.C.R.F. Massy)	CHILI	77,65	18,28				4,25	95,93
Pecten maximus (lavé/washed) (I.F.R.E.M.E.R.)	FRANCE	77,25	17,68	4,09			4,37	94,93
Pecten maximus (lavé/washed) (I.F.R.E.M.E.R.)	FRANCE	77,45	17,18	3,61	0,73	1,02	4,50	94,63

TABLEAU 2

COMPOSITION DES PECTINIDES - PROXIMATE COMPOSITION OF SCALLOPS (g p.100 g.)

Noix congelées sans corail lavées non trempées obtenues à partir de coquilles vivantes
washed unsoacked frozen muscles without, from alive scallops.

Espèces - Species / Substance		Origine	Humidité Moisture	Protéïnes Proteins (Nx 6,25)	Glucides Carbohydr.	Lipides Fat	Cendres Ash	H/P	H+P
Pecten maximus (IFREMER 1987)		France	75,72	17,55				4,31	93,27
Pecten maximus (IFREMER 1990)		France	77,57	17,29				4,48	94,86
Pecten maximus (IFREMER)	Décembre 1984	France	75,1	18,5	2,2	0	4,1	4,06	93,6
	Janvier 1985	"	75,4	19,3	2,7	0,6	2,3	3,90	97,4
	Mars 1985	"	77,1	18,5	0,6	0	2,2	4,15	95,6
	Avril 1985	"	76,7	17,6	1,2	0,1	2,3	4,37	94,3
	Juin 1985	"	75,3	17,8	1,7	0,2	3,4	4,23	93,1
	Juillet 1985	"	76,6	18,5	1,4	0,1	2,2	4,14	95,1
	Septembre 1985	"	76,2	18,6	0,8	0,1	2,5	4,10	94,8

TABLEAU 3 - INFLUENCE DE L'ENTREPOSAGE SUR LA COMPOSITION DES NOIX DE St-JACQUES FRAICHES

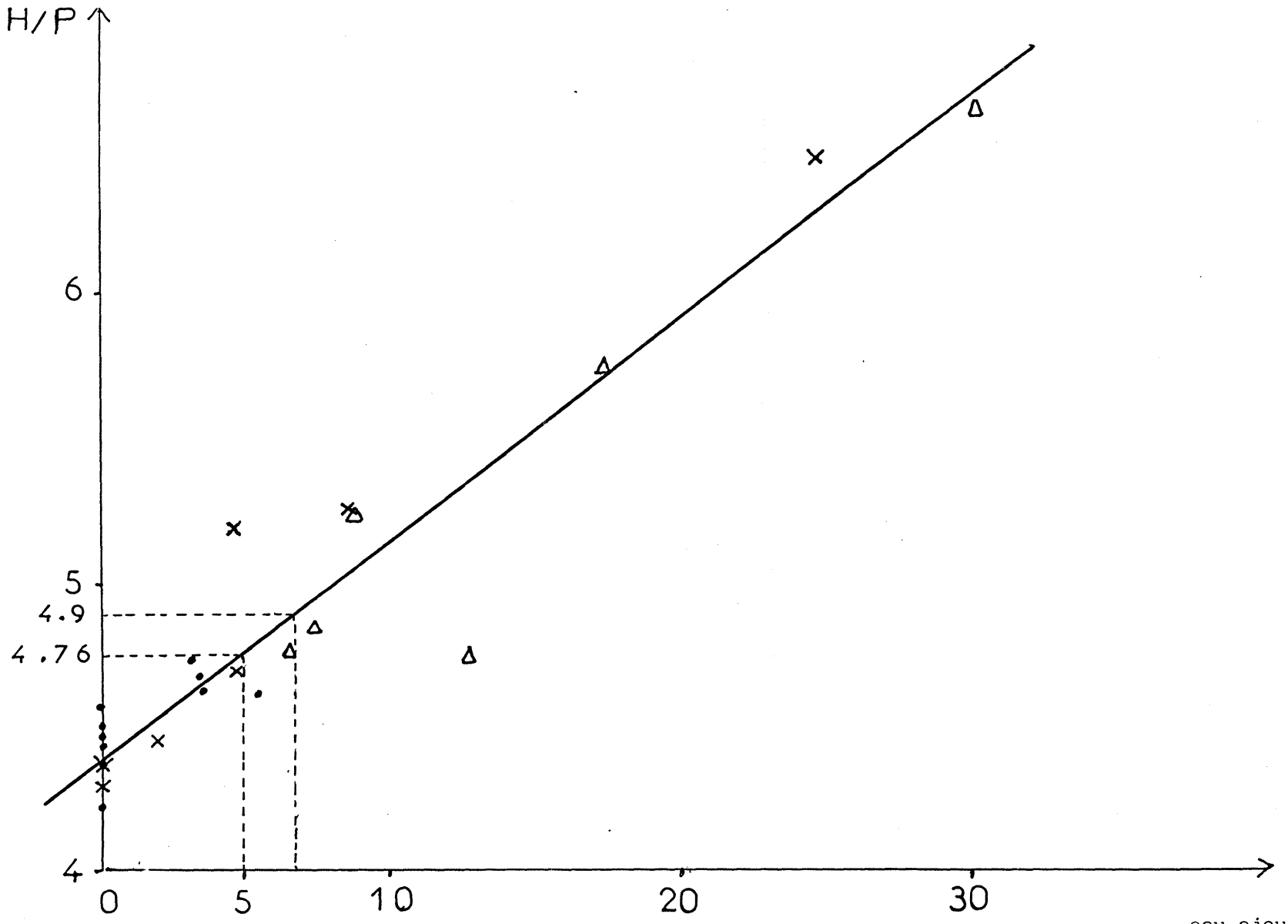
INFLUENCE OF STORAGE ON THE COMPOSITION OF FRESH SCALLOP MUSCLES

Jours Day	Etat Condition	Humidité Moisture	Protéïnes N x 6,25 Protéins	H/P	H + P	A.B.V.T. mg % g T.V. B.N.	T.M.A. mg % g	Phosphore avant hydrolyse	Phosphore Total
1)	Entreposage des coquilles entières vivants en chambre froide (4°C) Storage of alive scallops in a refrigerated room (4°C) a) Noix lavées non trempées/washed unsoaked muscles								
0	vivantes/alive	77,45	17,18	4,51	94,63	4,72	2,22	0,30	0,66
2	1/3 mortes/dead	77,25	17,68	4,37	94,63	6,67	2,78	0,42	0,70
5	100 % mortes/dead	77,12	18,25	4,22	95,37	9,73	2,50	0,55	0,57
	b) Noix trempées 15 mn/ 15' soaked muscles								
0	idem a)	77,89	16,81	4,63	94,70	3,89	2,50	0,34	0,66
2		78,10	16,68	4,68	94,78	3,06	1,95	0,42	0,60
5		78,34	16,50	4,74	94,84	7,78	1,95	0,54	0,58
2)	Noix prélevées sur des coquilles vivantes entreposées en sacs plastique scellés en glace Muscles removed from alive scallops, put in sealed plastic bags and stored in ice								
2		78,02	17,40	4,48	95,42	6,95	1,95		
5		78,03	17,55	4,47	95,58	8,89	2,78		
7		78,22	17,09	4,57	95,31	10,1	3,3		

Tableau 4 - BILAN DE L'EAU AJOUTEE / ADDED WATER BALANCE-SHEET

Echantillons Samples	Eau ajoutée/Added water			H/P	Déglaz.	Calcul de l'eau ajoutée Calculated added water		
	T	G	Total		G'	g	x	xt
Fo				4,51				
Co d				4,48				
Co g		6,4		4,78	7,1	4,9		4,9
Fo E 15	3,5			4,63			2,0	
Co E 15 d	2,0			4,45			0	
Co E 15 g		5,3	7,3	4,84	6,9	6,4		6,4
Fo E 30	5,5			4,61			1,7	
Co E 30 d	4,7			4,70			4,2	
Co E 30 g		3,9	8,6	5,25	9,0	8,2		12,3
F2				4,37				
F2 E 15	3,4			4,68			5,2	
F5				4,22				
F5 E 15	3,1			4,74			8,6	
A d				4,31				
A g		12,7		4,74	9,8	7,1		7,1
B d	4,7	9,1		5,20	6,5		13,7	
C d	8,5			5,26			14,6	
C g		8,8	16,6	5,78	10,3	8,8		20,7
D d	24,4			6,46			28,0	
D g		7,4	30,1	6,65	10,8	2,4		29,5

WATER PROTEIN RATIO INCREASE AS A FUNCTION OF ADDED WATER



• Fresh scallop muscles

× Frozen deglazed muscles

Δ Frozen glazed muscles