URI Sea Grant Program

Reports on...

#3

Nutrition Retention in Processed Codfish Products

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The U.S. Senate Select Committee on Nutrition and Human Needs in 1977 recommended seafood as an important component of the American diet, since it is a source of high quality protein, unsaturated fat, minerals and vitamins. Due to the recent public awareness of health and nutrition, fish is slowly assuming a greater role in the American diet. Though the consumption trend has been toward fresh fish, there is a variety of processed and, of course, cooked forms marketed widely. While preservation and processing can improve the palatability and appearance of food, a loss of nutrients accompanies any processing method, with the highest nutrient loss occurring in home preparation (IFT Expert Panel, 1974). Just how much change in nutrients in fish is caused by various cooking methods has only recently begun to be examined.

A data base for nutritional information on seafood is available through Sea Grant and the National Marine Fisheries Service (NMFS); however, most of the information is on raw seafood products. There is still insufficient information on the nutrient content of fish after industrial processing and subsequent home cooking (NMFS, 1982).

Nutrient Assessment

Under Sea Grant funding, researchers at URI evaluated the effect of processing and cooking on the nutritional value of fish. Production lines for battered and breaded codfish portions to be fried or baked by the consumer (see Figure 1) were sampled. Nutrient analyses on the fish muscle were done on original frozen Atlantic cod blocks, and then during each stage of processing and after baking or deep-fat frying according to the manufacturer's directions. Fresh, eviscerated Atlantic cod was also analyzed for comparison purposes.

After removing the batter/breading, the protein, fat, moisture, ash, thiamin, and niacin content were determined for each codfish sample. Levels of iron, calcium, sodium, magnesium, and zinc were trace elements which were specifically determined. (Figure 2, 3).

What Are the Results? What Do They Mean?

The composition of industrially frozen Atlantic cod blocks was extremely

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SAMPLE PROCESSING SCHEME

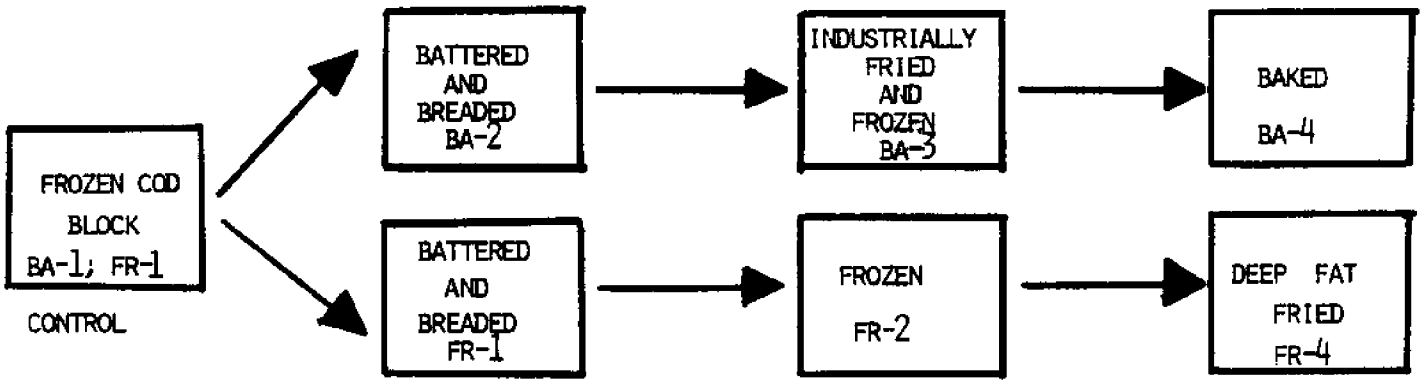

Figure 1

NUTRIENT PROFILE OF PROCESSED "BA" SAMPLES

	PROCESSED SAMPLES			
COMPONENT	BA-1	BA-2	BA-3	BA-4
MOISTURE (%)	82.36 ± 0.28	82.59 ± 0.39	80.88 ± 0.34*	74.40 ± 0.20*
ADJUSTED FOR MOISTURE CHANGES				
PROTEIN	16.43 ± 0.77	17.3 ± 0.13	14.93 ± 0.08*	13.81 ± 0.37*
LIPID (%)	0.89+	0.72 ± 0.04*	0.89 ± 0.07	1.04 ± 0.14
ASH	1.11 ± 0.03	1.14 ± 0.06	0.94 ± 0.04*	1.09 ± 0.02
B.(MG/100G)	66.47 ± 24.52	67.71 ± 12.69	71.60 ± 33.95	54.92 ± 4.78
NIACIN(MG/100G)	1.68 ± .39	1.20 ± .16	—	0.69 ± .15*
NA	1427.96 ± 55.31	2463.53 ± 42.14*	2040.03 ± 51.97*	1937.44 ± 86.59*
CA	139.36 ± 5.95	166.86 ± 1.19	122.61 ± 5.49*	107.62*+
ZN (PPM)	6.57 ± 1.72	5.06 ± 0.85	5.10 ± 1.46	6.09 ± 2.16
FE	5.22 ± 0.77	7.65 ± 3.10	4.07 ± 1.0	5.72 ± 2.14
MG	209.42 ± 20.61	206.50 ± 7.32	170.94 ± 6.01*	136.23 ± 3.95*

* SIGNIFICANT DIFFERENCE FROM BA-1 AT P < 0.05

+ DUPLICATE ANALYSIS ONLY

Figure 2

NUTRIENT PROFILE OF PROCESSED 'FR' SAMPLES

	PROCESSED SAMPLES			
COMPONENT	FR-1	FR-2	FR-3	FR-4
MOISTURE (%)	82.49 ± 0.57	82.74 ± 0.23	81.86 ± 0.77	74.08 ± 0.38*
ADJUSTED FOR MOISTURE CHANGES				
PROTEIN	16.22 ± 0.70	15.66 ± 0.97	13.99 ± 0.38*	13.49 ± 0.24*
LIPID (%)	0.92+	0.73 ± 0.07*	0.76 ± 0.04*	0.81 ± 0.34
ASH	1.35 ± 0.02	1.14 ± 0.06*	1.08 ± 0.04*	0.91 ± 0.04*
B1(UG/100G)	65.04+	62.17+	58.34 ± 9.4	53.69 ± 1.32*
NIACIN(MG/100G)	2.50 ± 0.56	2.62 ± 0.50	—	0.80 ± 0.17*
NA	1818.22 ± 62.22	2353.94 ± 75.72*	1966.10 ± 81.05*	1486.67 ± 24.54*
CA	178.60 ± 30.63	151.07 ± 9.06	138.13 ± 9.19*	122.18 ± 24.54*
ZN (PPM)	3.78 ± 0.46	4.48 ± 0.59	5.07 ± 1.11	2.84 ± 0.23*
FE	4.04 ± 0.87	8.46 ± 3.96	3.30 ± 0.36	3.51 ± 0.63
MG	227.11 ± 5.64	206.66 ± 10.06*	186.21 ± 8.05*	127.49 ± 1.32*

* SIGNIFICANT DIFFERENCE FROM FR1 AT P < 0.05

+ DUPLICATE ANALYSIS ONLY

Figure 3

close to the fresh Atlantic cod (see Figure 4). This indicated that the overall nutritional quality of the fish was maintained during the process of freezing and subsequent handling.

However, our research found a large, 180 percent, increase in sodium levels in the frozen block samples. This significant increase in sodium content in frozen cod may reflect the use of refrigerated seawater, brine, and/or polyphosphate prefreezing treatments. The sodium content of the fish muscle in both processes increased approximately 30 percent with the batter/breading process. Cooking reduced the sodium level in the fish tissue, but the level was still much higher than in the fresh counterpart. Since the batter and breading was not analyzed, it is not known how much of the sodium actually migrated with the water into the breaded coating or was lost from the product as part of the drip.

With increasing public awareness of sodium and its implications for high blood pressure, the sodium levels in both the frozen sections and the batter/breaded products could be cause for concern. It will be increasingly important to monitor sodium in seafoods, as well as to develop products which minimize the levels of this element.

Overall, the nutritional loss during the industrial batter/breading process was minimal. This indicates high nutrient retention in the fish muscle when the product has been processed and handled correctly.

By far the largest impact on nutrient retention in the fish tissue occurred during cooking. The research indicated a significant moisture loss from the tissue after cooking. While this study did not include analysis of the coating, severe migration could be a problem if the nutrients actually leached out of the product and did not remain in the breading.

Finally, the codfish portions which were manufactured for preparation via baking (Figure 5) were generally nutritionally superior to the deep-fat pan-fried product (Figure 6). Therefore, the baked fish would be the product of choice for the consumer both for nutritional and for convenience reasons.

NUTRIENT COMPOSITION OF FRESH AND FROZEN ATLANTIC COD

COMPONENT	FRESH (RAW)	FROZEN (BLOCKS)
MOISTURE	79.05 ± 2.32	82.43 ± 0.42*
PROTEIN (%)	19.10 ± 1.42	16.33 ± 0.69*
LIPID	0.83 ± 0.23	0.91 ± 0.05
ASH	1.03 ± 0.15	1.21 ± 0.13*
B_1 (µG/100G)	76.62 ± 1.24	65.90 ± 17.62
NIACIN (MG/100G)	2.60 ± 0.54	2.15 ± 0.55
FE	3.48 ± 0.31	4.63 ± 0.98
ZN	4.53 ± 0.80	5.17 ± 1.90
NA (PPM)	917.43 ± 46.45	1623.09 ± 215.61*
CA	84.63 ± 28.98	162.04 ± 30.12*
MG	217.41+	218.26 ± 16.89

* SIGNIFICANT DIFFERENCE AT $P < 0.05$

+ DUPLICATE ANALYSES ONLY

Figure 4

NUTRIENT RETENTION IN FROZEN, BREADED AND BAKED CODFISH PORTIONS (BA)

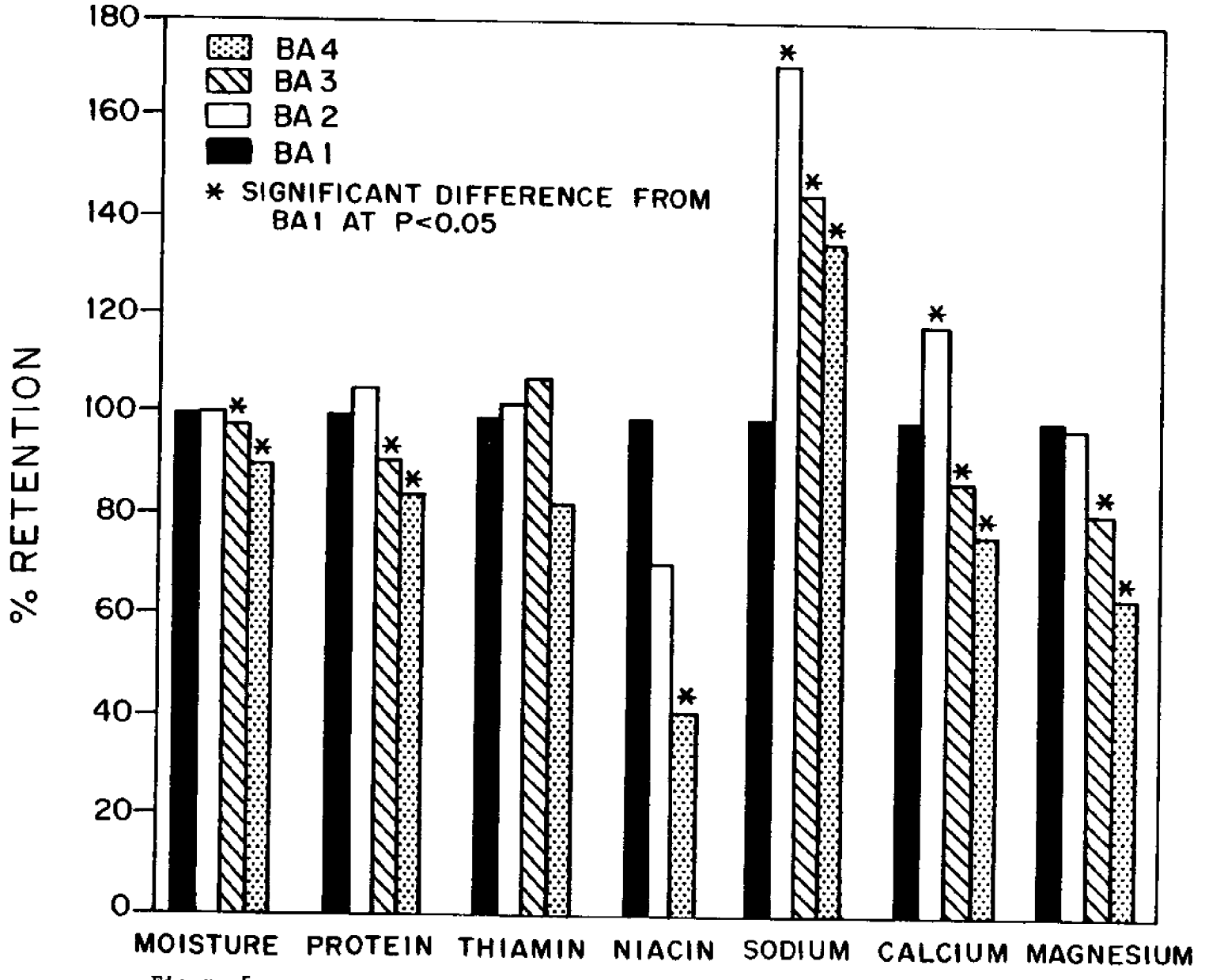

Figure 5
FR 1 Frozen cod block; FR 2 battered and breaded; FR 3 frozen; FR 4 deep-fat fried.

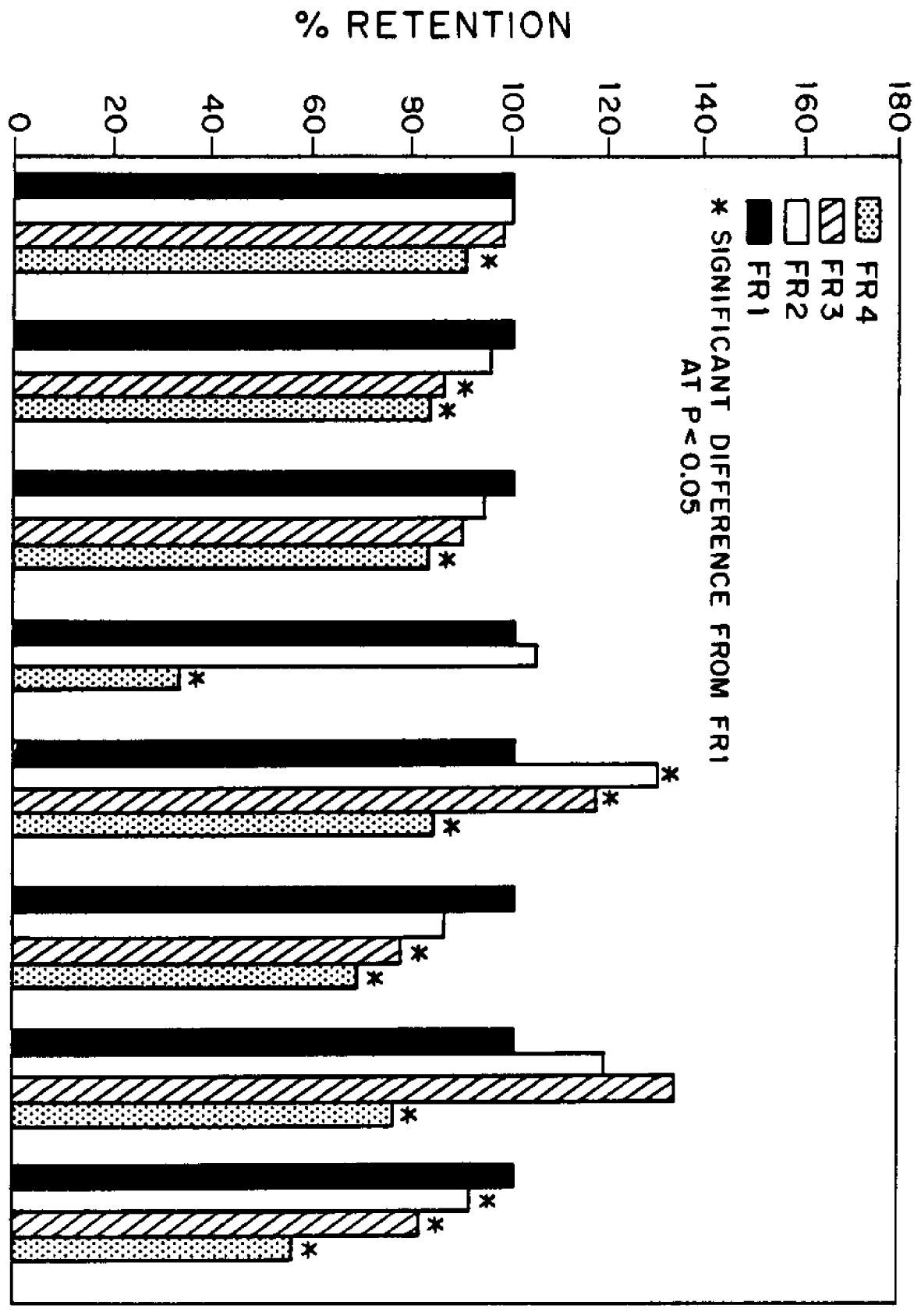

Figure 6
BA 1 Frozen cod block; BA 2 Battered and breaded; BA 3 industrially fried and frozen; BA 4 baked.