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# Sodium Survey of Canned and Frozen Fishery Products: 1982-83

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KEYWORDS: *Fishes,*Food composition, *Regulations.

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# SODIUM SURVEY OF CANNED AND FROZEN FISHERY PRODUCTS: 1982-83

by

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## ABSTRACT

In 1982, the Food and Drug. Administration proposed new regulations concerning the labeling of sodium content of foods. The potential impact of these proposed regulations on the fishing industry led the National Marine Fisheries Service to survey the sodium content of some retail canned and frozen fishery products in both 1982 and 1983. The initial survey in 1982 provided baseline information, whereas the survey in 1983 provided the information necessary to assess the-interim response of the fishing industry to the new regulations. A comparison of the 1983 results with those in 1982 indicated that there was a significant reduction in the average sodium content of water-pack canned tuna, whereas no reduction was observed in the sodium content of oil-pack tuna, salmon, shrimp, and frozen fishery products. Canned tuna and salmon averaged about 1 to 1.2% salt as sodium chloride and canned shrimp averaged about 2 to 2.5% salt, with some samples averagingabout 4% salt. The large variability of sodium levels within lots of canned tuna and salmon is a significant problem to the industry because it requires the labeled amount of sodium to be in excess of the lot average.

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## INTRODUCTION

In 1982, the Food and Drug Administration (FDA) proposed new regulations concerning the labeling of sodium content of foods (Federal Register 1982). Comments from the food industry and other government agencies were invited and, in 1984, the finalized regulations were published (Federal Register 1984). An effective date of 1 July 1985 was set, and subsequently extended by 1 year to 1 July 1986. For fishery products, a change in the definition of "low sodium" in the finalized regulations was significant (Table 1). Under the 1982 proposed regulations, fresh fish could only be labeled a "moderately low sodium" product, whereas under the final rules, fresh fish can be termed a "low sodium" product--more in keeping with the nutritional view of seafood.

The potential impact of these regulations on the fishing industry led the National Marine Fisheries Service to conduct a limited survey and determine the sodium content of retail canned and frozen fishery products in the early part of 1982. This survey was intended to provide baseline data on the sodium content of retail fishery products. Approximately l-1/2 years later, a similar survey was conducted to assess the interim response of the fishing industry to the new regulations. This report describes and compares the results of the two surveys.

## MATERIALS AND METHODS

Samples of canned tuna, salmon, and shrimp and frozen fishery products were purchased in Seattle retail stores in the spring and summer of 1982 and the fall of 1983. Twelve cans of tuna, salmon, and shrimp and 12 boxes of frozen fishery products were purchased from each label manufacturer

Table 1.--Food and Drug Administration proposed and final regulations concerning the labeling of sodium in foods.

| Descriptor | Proposed 1982 | Final 1984[a] |
|---|---|---|
| Sodium free | 5 mg or less per serving | 5 mg or less per serving |
| Very low sodium | - - - | 35 mg or less per serving |
| Low sodium | 35 mg or less per serving | 140 mg or less per serving |
| Moderately low sodium | 140 mg or less per serving | - - - |
| Reduced sodium | 75% reduction of sodium for a direct replacement food. | 75% reduction of sodium for a direct replacement food. |
| "No salt added" or "unsalted" | No sodium chloride added during processing. Must bear quantitative information on sodium content. | No salt added during processing; food it resembles and for which it substitutes is normally processed with salt; quantitative sodium information on sodium content. |

[a] Regulation took effect 1 July 1986 (21CFR part 101.13).

(Brand), with at least 6 cans or packages having the same product codes (In 1982, only 6 cans of shrimp from each brand were used.) Brands are identified by letters, A, B, C, etc. Each letter holds for a specific brand throughout this report.

The contents of the canned samples were drained in a sieve for 2 minutes and the meat portion was homogenized. One subsample each of meat and drained liquid (5 g) were taken for separate analysis. Breading and batter coatings were separated from the meat portion and analyzed separately for sodium (Teeny et al. 1984).

Total sodium content was calculated for each product based on the portion weights collected from each sample. All sodium values are reported as mg%, i.e., milligram per 100 grams of sample. Conversion of mg% sodium to percent salt used the formula: % salt = mg% sodium/393.4. Statistical calculations and analyses were performed by the SPSS suite (release 9.1) of computer programs (SPSS Inc., Chicago, IL 60611).

## RESULTS

### Water-Pack Tuna

Five brands of water-pack tuna were analyzed in both 1982 and 1983 (Table 2). Brands A, B, C, and D showed reductions of 33%, 19%, 63%, and 16%, respectively, whereas Brand E showed an increase of 20% in sodium. Brand E was the most variable product examined in 1983, having the highest standard deviation (244), the greatest coefficient of variation (60%), and the greatest range between the lowest to the highest value (208 to 1034 mg%). Detailed sodium data for Brand E show that there was a large within-code variation (Table 3) which may be due to large variations in

Table 2.--Sodium content of water-packed canned tuna.

| Year/ Brand | Range mg% | Mean mg% | Std. dev. | Coeff. var. (%) |
|---|---|---|---|---|
| 1982 A | 371 - 599 | 464 | 72 | 15 |
| 1983 A | 177 - 617 | 3l3** | 113 | 36 |
| 1982 B | 326 - 790 | 563 | 164 | 29 |
| 1983 B | 308 - 625 | 457 | 93 | 20 |
| 1982. C | 366 - 993 | 536 | 162 | 30 |
| 1983 C | 102 - 352 | 196** | 73 | 37 |
| 1982 D | 159 - 525 | 404 | 102 | 25 |
| 1983 D | 210 - 505 | 339* | 78 | 23 |
| 1982 E | 152 - 488 | 340 | 95 | 28 |
| 1983 E | 208 - 1034 | 409 | 244 | 60 |
| 1982 Industry (60) | 340[a] - 563[a] | 461 | 146 | 32 |
| 1983 Industry (60) | $196_a$ - 457[a] | 343** | 159 | 46 |

* or ** Significance difference between 1982 and 1983 means *P<0.l or **P<0.0l (t-test).

[a] Lowest and highest means of the brands from the industry are used.

Table 3. --Sodium content of the water-pack tuna of Brand E for the year 1983.

| Can number | Sodium in meat mg% | Sodium in liquid mg% | Total sodium mg% |
|---|---|---|---|
| Same code lot, individual cans | | | |
| 1 | 281 | 363 | 295 |
| 2 | 631 | 814 | 657 |
| 3 | 994 | 1301 | 1034 |
| 4 | 578 | 745 | 602 |
| 5 | 316 | 444 | 336 |
| 6 | 407 | 529 | 426 |
| Avg. | 535 | 699 | 558 |
| Std. dev. | 265 | 342 | 274 |
| Coeff. of var. (%) | 50 | 49 | 49 |
| Different code lots, individual cans | | | |
| 1 | 212 | 272 | 227 |
| 2 | 254 | 330 | 268 |
| 3 | 253 | 326 | 269 |
| 4 | 342 | 438 | 365 |
| 5 | 218 | 248 | 224 |
| 6 | 188 | 265 | 208 |
| Avg. | 245 | 313 | 260 |
| Std. dev. | 54 | 70 | 57 |
| Coeff. of Var. (%) | 22 | 22 | 22 |

the salt content of the tuna before processing. Overall industry averages indicate that the industry significantly lowered the sodium content of its water-pack tuna by almost 26% from a mean of 461 mg% to 343 mg%. Variability, as estimated by the standard deviation, remained similar for both years; however, the coefficient of variation for 1983 was larger (46%) than in 1982 (32%) due to the reduction in the sodium content from a mean of 464 mg% to 3l.3 mg%.

## Oil-Pack Tuna

The combined industry averages of sodium content in oil-pack tuna showed no significant difference between 1982 and 1983 (Table 4), although Brand C showed a reduction of 49% and Brand E an increase of 70%. Variability was minor among each of the producers, except for Brand E. In 1983, sodium values in Brand E ranged between 128 mg% and 709 mg% and accounted for a large standard deviation.

## Diet-Pack Tuna

Within the last several years, two kinds of “diet” packs of tuna have appeared more frequently in the retail market: “no salt added” and “reduced salt." “Reduced salt” packs are labeled as either “50% less salt” or “60% less salt." The reduction referred to in these label declarations are relative to the manufacturer’s standard salt-added water pack. The “no salt added” packs of tuna usually averaged below 50 mg%, with the exception of Brand F in 1983, where the salt content was double that amount (Table 5). Brand B “60% less salt” contained substantially less than the 60% declaration (91% less salt than its regular water-pack for 1982 and 87% less for 1983).

Table 4.--Sodium content of oil-pack canned tuna.

| Year/ Brand | Range mg% | Mean mg% | Std. dev. | Coeff. var. (%) |
|---|---|---|---|---|
| 1982 A | 265 - 615 | 452 | 136 | 30 |
| 1983 A | 208 - 624 | 441 | 137 | 31 |
| 1982 B | 83 - 534 | 321 | 108 | 34 |
| 1983 B | 178 - 454 | 290 | 84 | 29 |
| 1982 C | 387 - 711 | 512 | 99 | 19 |
| 1983 C | 161 - 430 | 261** | 84 | 32 |
| 1982 D | 284 - 408 | 374 | 46 | 12 |
| 1982 D[a] | 57 - 77 | 67 | 8 | 12 |
| 1983 D | 250 - 491 | 384 | 74 | 19 |
| 1982 E | 133 - 370 | 252 | 63 | 25 |
| 1983 E | 128 - 709 | 429* | 163 | 38 |
| 1982 Industry | 252[b] - 512[b] | 349 | 162 | 46 |
| 1983 Industry | 261[b] - 441[b] | 361 | 132 | 37 |

* or ** Significant difference between 1982 and 1983 means, *p<0.l or **p<0.0l (t-test>.

[a] Sample (6 cans) all from one code lot, apparently no salt added to these cans.

[b] Lowest and highest means of the Brands from the industry used.

Table 5.--Sodium content of diet-pack canned tuna.

| Year/ Brand | Declared salt content | Range mg% | Mean mg% | Std. dev. | Coeff. var. (%) |
|---|---|---|---|---|---|
| 1982 A | No salt added | 40 - 49 | 45 | 3 | 6 |
| 1983 A | No salt added | 35 - 55 | 45 | 7 | 15 |
| 1982 A | 50% less salt | --- --- | --- | --- | --- |
| 1983 A | 50% less salt | 126 - 235 | 191 | 50 | 26 |
| 1982 B | No salt added | 33 - 47 | 39 | 5 | 13 |
| 1983 B | No salt added | --- --- | --- | --- | --- |
| 1982 B | 60% less salt | 40 - 52 | 45 | 5 | 10 |
| 1983 B | 60% less salt | 38 - 143 | 58 | 34 | 58 |
| 1982 F | No salt added | 33 - 59 | 49 | 7 | 13 |
| 1983 F | No salt added | 46 - 160 | 104 | 54 | 53 |

## Salmon

Canned salmon is generally produced by a variety of packing plants in Alaska and other west coast areas and then shipped to a central distribution center where the cans may be sold to various distributors who may place their own label on the product. Therefore, a comparison of given brands from one year to the next may not be meaningful, since the products under comparison may be from two or more different packers.

Sodium contents of canned salmon samples analyzed in 1983 generally increased over the values observed in 1982 (Table 6). The overall industry averages were 446 mg% for 1982 and 504 mg% for 1983, and the variability was about the same.

Among the brands, Brand C/pink and Brand G/sockeye showed 35% and 31% increases in 1983 over the 1982 values, respectively. The remaining brands were virtually unchanged both years.

## Canned Shrimp

Two of four brands showed rather large increases in 1983 over 1982--Brand C increased from 716 mg% to 1425 mg% and Brand I from 771 mg% to 1081 mg% (Table 7). For 1982, the overall industry coefficient of variation was large (55%), but the individual coefficient of variation for each brand was quite small (ranging from a low of 1% to a high of 12%). On the other hand, the coefficient of variations in 1983 ranged from 11 to 30%.

Since sampling in 1982 used only 6 cans from each brand compared to 12 cans in 1983 and due to large differences in standard deviations from one year to the next, a comparison of changes in brand means is statistically unwarranted.

Table 6.--Sodium content of canned salmon.

| Year/ Brand | Product | Range mg% | Mean mg% | Std. dev. | Coeff. var. (%) |
|---|---|---|---|---|---|
| 1982 C | pink | 296 - 466 | 402 | 48 | 12 |
| 1983 C | pink | 394 - 684 | 541** | 76 | 14 |
| 1982 C | sockeye | 138 - 495 | 391 | 94 | 24 |
| 1983 C | sockeye | 324 - 417 | 385 | 27 | 7 |
| 1982 D | sockeye | 550 - 645 | 606 | 27 | 5 |
| 1983 D | sockeye | 457 - 724 | 648 | 92 | 24 |
| 1982 F | pink | 143 - 602 | 466 | 132 | 28 |
| 1983 F | pink | 198 - 635 | 467 | 128 | 27 |
| 1982 G | Sockeye | 103 - 571 | 363 | 163 | 45 |
| 1983 G | Sockeye | 393 - 572 | 477* | 51 | 11 |
| 1982 Industry | | 363[a] - 606[a] | 446 | 135 | 30 |
| 1983 Industry | | 463[a] - 648[a] | 504** | 119 | 24 |

* or ** Significance difference between 1982 and 1983 means, *P<0.l or **P<0.0l (t-test).

[a]Lowest and highest means of the brands from the industry are used.

Table 7.--Sodium content canned shrimp meats.

| Year/ Brand | Number of samples | Range mg%. | Mean mg% | Std. dev. | Coeff. var. (%) |
|---|---|---|---|---|---|
| 1982 C | 6 | 578 - 820 | 716 | 88 | 12 |
| 1983 C | 12 | 710 - 1914 | 1425 | 338 | 24 |
| 1982 D | 6 | 1626 - 1669 | 1646 | 18 | 1 |
| 1983 D | 12 | 1590 - 3525 | 1704 | 211 | 12 |
| 1982 H | 6 | 725 - 829 | 763 | 44 | 6 |
| 1983 H | 12 | 700 - 933 | 776 | 86 | 11 |
| 1982 I | 6 | 708 - 816 | 771 | 37 | 5 |
| 1983 I | 12 | 273 - 1347 | 1081 | 327 | 30 |
| 1982 J | -- | --- --- | --- | --- | -- |
| 1983 J | 12 | 785 - 1078 | 917 | 98 | 11 |
| 1982 K | 6 | 653 - 834 | 721 | 65 | 9 |
| 1983 K | -- | --- --- | --- | -- | -- |
| 1982 Industry | 30 | 716[a] - 1646[a] | 1004 | 548 | 55 |
| 1983 Industry | 60 | 776[a] - 1704[a] | 1181 | 412 | 35 |

[a] Lowest and highest means of Brands of the industry for that year are used.

## Frozen Fishery Products

The overall industry sodium content of all frozen products tested in 1982 was 490 mg% and in 1983 was 508 mg%--up 4% (Table 8).

The coefficient of variation for the major share of the samples (15 out of 20) was well below 10%; the remainder had coefficient of variation between 10 and 28%.

Sodium data for the meat and breading indicate that the breading had a higher level of sodium than the meat. The sodium content of the meat and breading were highly correlated ($P<0.01$), probably due to migration of the salt.

## DISCUSSION

Wekell et al. (1983) described the problems of the fishing industry in meeting the requirements of the proposed sodium regulations (Table 1). The data collected in 1983 for this report, after an interval of 18 months, showed a significant reduction in sodium content of water-pack tuna only, and no change in the salt content of the oil-pack tuna or frozen products. There was some increase in salt content of salmon, shrimp, and diet-pack tuna (Fig. 1).

The ability of the fishing industry, particularly the tuna and salmon fisheries, to respond to reductions of sodium content variability in their products is somewhat limited when the nature of these fisheries is considered.. These fisheries are either long-distance fisheries (tuna) or highly compressed, seasonal fisheries (salmon). In either case, large quantities of fish are caught in short periods and must be held in some form of preserving storage to avoid spoilage or decomposition prior to

Table 8.--Sodium content of frozen breaded/battered fishery products.

| Year/ Brand | Product | Total sodium mg% | Std. dev. | Coeff. of var. ( % ) | Sodium in meat[a] mg% | Sodium in breading mg% |
|---|---|---|---|---|---|---|
| 1982 X | Fillets | 357 | 35 | 10 | 303 (16) | 409 (7) |
| 1983 X | Fillets | 561 | 33 | 6 | 460 (13) | 659 (2) |
| 1982 X | Sticks | 702 | 33 | 5 | 505 (8) | 868 (6) |
| 1983 X | Sticks | 694 | 34 | 5 | 499 (11) | 847 (6) |
| 1982 X | Cakes | 551 | 39 | 7 | 462 (8) | 780 (10) |
| 1983 X | Cakes | 457 | 37 | 8 | 338 (10) | 661 (9) |
| 1982 Y | Fillets | 401 | 33 | 8 | 382 (14) | 413 (6) |
| 1983 Y | Fillets | 451 | 49 | 11 | 431 (18) | 434 (9) |
| 1982 Y | Sticks | 447 | 125 | 28 | 422 (32) | 463 (28) |
| 1983 Y | Sticks | 490 | 37 | 8 | 393 (3) | 556 (11) |
| 1982 Y | Kabobs | 460 | 66 | 14 | 316 (29) | 590 (10) |
| 1983 Y | Kabobs | 549 | 22 | 4 | 417 (2) | 665 (6) |
| 1982 Z | Fillet | 469 | 17 | 4 | 317 (12) | 591 (3) |
| 1983 Z | Fillet | 414 | 21 | 5 | 303 (16) | 505 (9) |
| 1982 Z | Sticks | 461 | 18 | 4 | 384 (8) | 508 (4) |
| 1983 Z | Sticks | 572 | 66 | 12 | 334 (38) | 753 (5) |
| 1982 Z | Kabobs | 472 | 17 | 4 | 335 (9) | 583 (4) |
| 1982 R | Portions | 527 | 20 | 4 | 662 (5) | 426 (4) |
| 1982 S | Cakes | 661 | 10 | 2 | 642 (2) | 688 (1) |
| 1983 T | Fillets | 386 | 72 | 19 | 309 (20) | 460 (18) |
| 1982 | All frozen products | 490 | 104 | 24 | 430 (29) | 574 (27) |
| 1983 | | 508 | 96 | 19 | 387 (18) | 615 (22) |

[a] Number in parentheses is the coefficient of variation expressed as percent.

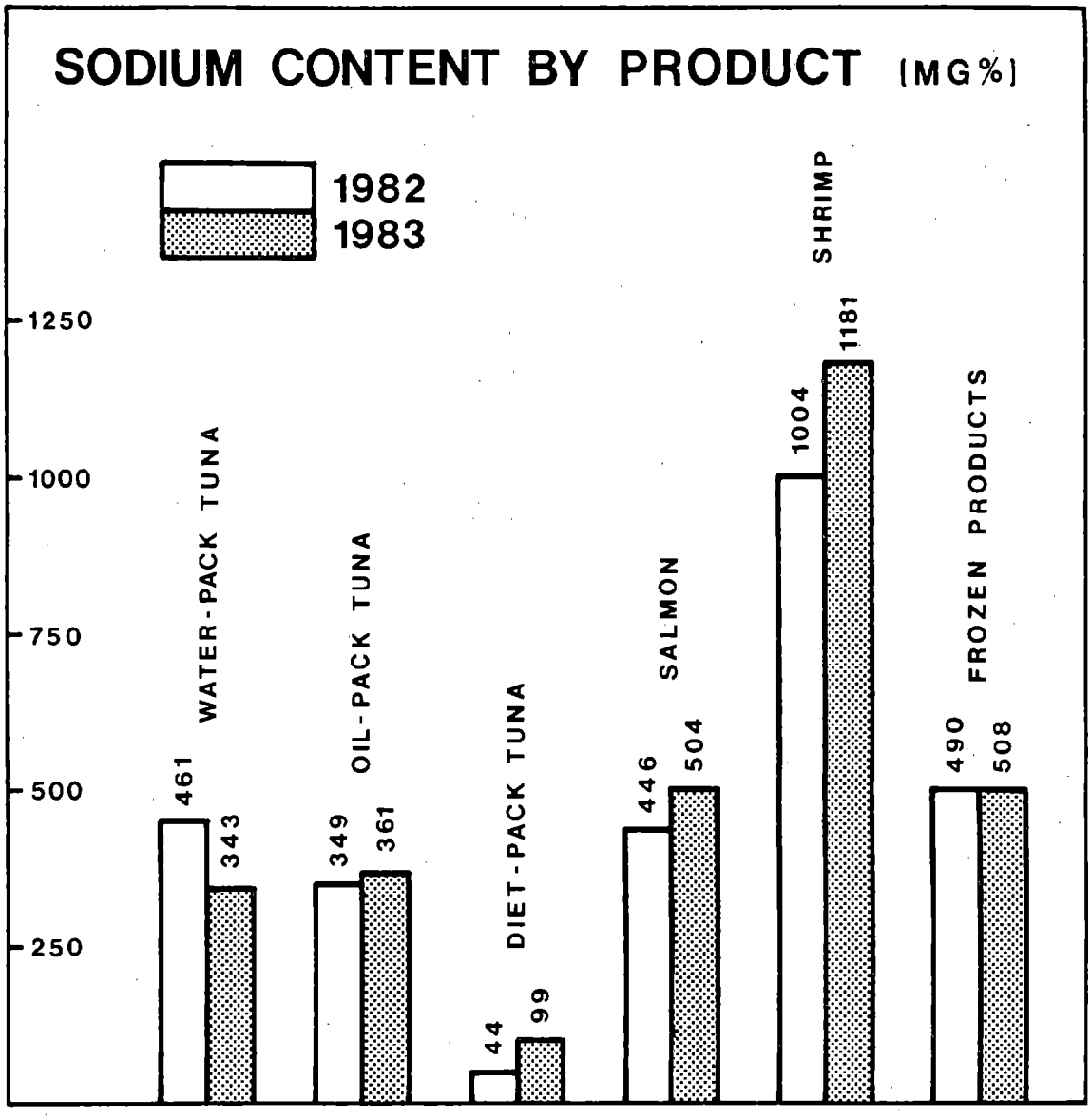


Figure l.--Sodium levels in various canned and frozen fishery products for 1982 and 1983.

processing. In "near shore" fisheries, ice, refrigerated seawater (RSW), and blast freezing typically can be used to hold catches until return to port. However, the use of the traditional ice-holding or blast-freezing methods can be impractical in a long-distance fishery from the standpoint of cost and capacity needed. Within these constraints, the fishing industry relies heavily on freezing-brine (salt) and RSW technologies to preserve their catch. Unfortunately, both of these chilling methods lead to high salt uptake into fish held in either brine or RSW (Wekell et al. 1983; Patterson et-al. 1984).

In regard to salt uptake, the most troublesome method is brine freezing in the tuna industry. Soon after the catch, the tuna are placed directly in the freezing brine (23% by weight) and held over a period of several days; however, in some cases fish have been stored in the freezing brine for up to 3 months. Depending on how long the tuna are held in the brine, some tuna entering ports in California contained as much as 6% sodium chloride (Wekell and Teeny 1984, pers. commun.). In order to use these high-salt fish, a current practice is to blend high-salt tuna with low-salt tuna during the canning operation to achieve a final product containing about 1 to 2% sodium chloride. Recognizing the added cost burden of handling these high-salt fish, the tuna industry began imposing monetary penalties on boats delivering tuna containing high salt levels. These economic penalties and pressure from the canning industry have forced catcher boats to closely adhere to the FDA's Good Manufacturing Practices (GMP) of minimizing the contact of fish with RSW or brine during the freezing process. In general, after fish are frozen they are removed from the brine solution and kept in dry frozen storage and then air or fresh-water thawed.

The salmon industry in Alaska relies heavily on RSW (Roach et al. 1967), and to some small extent on brine freezing, for holding enormous catches prior to processing. When the salmon runs are on, processing plant capacity can be exceeded for days on end; therefore, the holding of salmon in RSW or brine freezing during transport from the fishing grounds to the cannery can contribute significant amounts of salt and variation in the salt content. Two factors were found to be major contributors to salt' variation due to uptake in RSW systems (Wekell et al. 1983; Patterson et al. 1984): 1) size of the fish and 2) length of time the fish are held in RSW. For example, the daily addition of fish to a single RSW holding tank without daily segregation for a period of 5-7 days can lead to coefficient of variations of 50% when calculated for the complete catch.

Breaded and battered frozen fishery products, unlike canned products, show very small variabilities. The level of salt or sodium (added as flavor enhancers, drip controllers, etc.) is much more controllable in these products. Our data 'indicate that 'the breading is the major contributor to the total salt load of the product; therefore, a reduction in the sodium content of the breading could result in a significant reduction of sodium in the breaded product.

In summary, our data indicate that with the exception of water-pack tuna, little has been done to lower either the content or the variability of sodium in fishery products. In view of our findings of the large variability in the sodium content of canned fishery products, it would appear that label declarations of the sodium content of these products may have to be far in excess of the lot or data-base mean in order to be in

compliance with the +20% rule of FDA for label declarations. Paradoxically, one way to lower sodium variability is to increase the salt content of the food; however, this is hardly in keeping with the national goal of lowering the sodium content of our foods. Cur data show that the lowering of the sodium content of the water-pack tuna in 1983 was associated with an increase in sodium variability. Clearly, a reduction in sodium content might be achieved but a reduction in variability is going to be a more difficult task for the fishing industry. Cur information indicates that, since this survey, industry practices are being oriented in this direction, and periodic analysis by this laboratory will assess the degree of progress that is being achieved.

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