Results

Table I presents data showing recovery of 3,5-dinitrobenzamide added to a feed as compared to the color developed by the pure material. The method used was exactly as previously described. The absorption maxima were determined using a Beckman DK-2 ratio-recording spectrophotometer (Figure 1).

The data in Table II were intended to show that the source of feed has little effect on the recovery of added 3,5-dinitrobenzamide. The presence of other medications was not detrimental to the results. Samples 1 and 5 contained 3-nitro-4-hydroxyphenylarsonic acid, *N,N'*, di-(3-nitrobenzenesulfonyl) ethylenediamine, and N^4-acetyl-*N*-(4-nitrophenyl) sulfanilamide. Sample II contained 3 - nitro - 4 - hydroxyphenylarsonic acid and nitrophenide [bis(3 nitrophenyl)-disulfide]. All the feeds shown are poultry feeds chosen to be representative of the extremes normally encountered. Two milliliters of a 100-γ-per-ml. solution of 3,5-dinitrobenzamide in acetone were added to 2.0 grams of each of the samples in Table II.

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FISH STORAGE EFFECTS

Composition Changes in Puget Sound Pink Salmon during Storage in Ice and in Refrigerated Brine

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To determine the changes taking place in fish flesh under different storage conditions, the composition and quality of Puget Sound pink salmon were determined shortly after capture, during storage in ice, and during storage in chilled brine. Large variations were found in the dorsal, ventral, and belly flap parts, but variations were small in the light meat or steak sections. Fish about ready to spawn showed a great depletion of the oil reserves in all parts of the fish. Storage of fresh and of brine chilled specimens in ice caused extensive leaching of the ash, sodium, and potassium contents. Storage in brine greatly increased the content of ash and of sodium. Such changes would have special significance in the preparation of a "dietetic" or low-sodium product.

Salt-water fish is usually preserved from the time of capture until delivery to the processor or consumer by ice or more recently by refrigerated brine (*6, 7*). Although brine is more commonly used with tuna (*5*), in this study, pink salmon, owing to its ready availability to the Seattle laboratory, was used to compare the effect of the two methods on keeping quality. The physical and chemical changes taking place in the flesh soon after capture, during storage in ice, and during storage in chilled brine were investigated. Storage periods of about 1 and 2 weeks were used, because it was felt these periods represent the maximum lengths of time fish would be retained on board ship or on land before being processed.

Description of Specimens

Puget Sound pink salmon (*Oncorhynchus gorbuscha*) captured with gill nets were placed in ice at the landing dock and brought immediately to the Seattle laboratory, where they were prepared for analysis. The physical data (Table I) for the specimens showed wide variation. Males and females were about equal in number. In size, they varied from small to large for the males (54 to 66 cm.) and from medium to large for the females (54 to 59 cm.). They ranged from a bright silvery green to a dark sand color with numerous watermarks. In the females, the roe varied from small and compact to large and separating. The hump and nose hook were slight in some males and very large in others.

Table I. Physical Data for Pink Salmon Used in Tests

Factor	Males	Females
Quantity	11	13
Length, cm.	54–66	54–59
Weight, grams	1845–3500	1990–2490
Color	Bright to dark	Bright to dull
Roe hump and hook	Small to large	Medium to large

Preparation of Samples

Samples were prepared from fresh fish, from fish stored in ice, and from fish stored in chilled brine.

Fresh. For the chemical analyses, seven samples were taken from each of six male and six female fish. The whole, cold fish was dipped in scalding water for a few seconds to loosen the skin, which then was peeled off. The fish was eviscerated, and the head removed. Three steak sections were taken from the nape, center, and tail. From the two remaining portions, the dorsal, lateral, dark muscle, and belly flaps were removed from the light meat. These in-

Table II. Composition of Male and Female Pink Salmon (Fresh Fish Flesh)

Part	Moisture, % Av.	Moisture, % Range	Oil, % Av.	Oil, % Range	Protein, % Av.	Protein, % Range	Ash, % Av.	Ash, % Range	Sodium, Mg./100 Grams Av.	Sodium, Mg./100 Grams Range	Potassium, Mg./100 G. Av.	Potassium, Mg./100 G. Range
Male												
Dorsal	65.1	58.6–69.2	24.4	18.5–32.4	11.0	9.7–14.6	0.8	0.6–0.9	145	103–184	131	103–148
Lateral	69.7	67.9–71.1	11.3	8.5–14.5	18.2	16.9–19.1	1.1	1.0–1.1	72	60–85	255	243–279
Belly flaps	72.9	71.2–74.4	8.8	6.1–11.6	18.1	16.6–18.8	1.0	1.0–1.1	108	87–125	257	226–295
Light meat	77.2	76.1–78.1	1.7	1.2–2.1	21.1	20.2–21.8	1.2	1.1–1.3	62	40–92	345	327–387
Nape	75.7	74.8–76.7	4.3	3.2–5.8	19.9	19.4–20.4	1.2	1.1–1.3	79	56–100	323	307–332
Center	76.2	75.1–77.3	2.8	2.0–3.8	21.0	20.4–21.5	1.2	1.2–1.3	66	47–98	330	303–356
Tail	76.6	75.6–77.4	2.7	2.0–3.5	20.8	20.5–21.2	1.2	1.1–1.3	79	58–105	321	292–351
Av. (N, C, T)	76.2	74.8–77.3	3.3	2.0–5.8	20.6	19.4–21.5	1.2	1.1–1.3	75	47–105	325	292–356
Female												
Dorsal	55.4[a]	41–72[a]	29.5	9.7–46.7	14.2	11.4–17.0	0.9	0.8–1.0	88	69–112	173	160–205
Lateral	67.3	63.7–72.3	13.7	8.4–18.5	18.5	17.4–19.7	1.1	1.0–1.3	67	57–72	263	234–292
Belly flaps	70.5	64.2–78.2	11.3	3.3–18.3	18.2	17.0–18.9	1.0	0.9–1.1	94	81–108	253	205–272
Light meat	76.7	75.6–78.4	2.3	1.9–2.9	21.1	20.1–21.6	1.3	1.2–1.4	57	38–66	352	328–381
Nape	74.6	72.6–78.2	5.5	2.5–7.9	19.7	19.1–20.6	1.3	1.2–1.3	69	54–76	333	319–365
Center	75.5	74.2–75.4	4.0	2.1–5.8	20.9	20.1–21.5	1.3	1.2–1.5	60	46–75	339	316–372
Tail	76.0	74.7–77.5	3.1	2.3–3.6	20.9	20.4–21.5	1.3	1.2–1.4	70	50–92	336	306–393
Av. (N, C, T)	75.1	72.6–78.2	4.1	2.1–7.9	20.5	19.1–21.5	1.3	1.2–1.5	66	46–92	336	306–393

[a] Not analyzed, values calculated by difference.

dividual samples were ground in a Hobart grinder, sealed under vacuum in half-pound salmon cans, and stored at −18° C. until analyzed.

Iced. Fifteen fish were eviscerated and stored in fresh-water flake ice at 1° C. After 8 days, they were removed and examined organoleptically. Samples for analysis were removed from three, and the others were again stored in ice for 6 days. They were again examined. Samples were removed from three specimens and the remaining nine were discarded. Dorsal, lateral, belly flap, and light-meat samples were prepared from each fish, as for the first group, and stored in the same manner.

Brine-Chilled. Another group of 15 fish were eviscerated and stored for 8 days in 27 gallons of a 3% solution of sodium chloride kept at 1° C. They were examined, and samples were prepared in the same manner as from the iced fish. The 12 remaining fish then were stored in ice for an additional 6 days. After being examined, three were used for the preparation of samples, and the remainder were discarded. Samples were prepared at once in a manner similar to that used for the first two groups.

Experimental Procedures

Physical Tests. Organoleptic tests for color, odor, taste, and firmness of flesh were made at the beginning and end of each phase in the procedure, by a panel of judges experienced in the handling and testing of fish.

Chemical Tests. Chemical analyses by standard methods, made on the individual samples, included the percentage determination of moisture (*2*), oil (*3*), protein (*1*), and ash (*4*). The ash from each sample was analyzed for sodium and potassium content (in milligrams per 100 grams of flesh) by means of a direct-reading flame photometer. The procedure used was adapted from one developed by the National Canners Association Research Laboratory (*10*).

Results and Discussion

Physical and chemical variations are considered on the basis of maximum variations, changes in the different constituents for fish with regard to size, sex, and maturity, fluctuations of one constituent with reference to another, and constituent variations under different storage conditions.

Maximum Chemical Variations. Chemical components show great variation in the different parts of pink salmon. Extreme values for all constituents were found in the dorsal or light meat parts (Table II). The highest values were found in the dorsal part for oil (47%) and sodium (184 mg. per 100 grams) and in the light meat for moisture (78%), protein (22%), ash (1.4%), and potassium (387 mg. per 100 grams). The lowest values were in reverse order to the above for dorsal and light meat parts. The variations with sex were minor and were not uniform for one sex over the other, except for oil and moisture.

Variations in Oil Content. In all samples, but one, the oil content of the male specimens had lower average values and ranges than that of the females (Table II). The differences in the steak sections, however, were not large. The minimum values listed for the females were all for one fish that was in poor condition and apparently about ready to spawn. In it, the dorsal part showed fivefold decrease in oil content, whereas the other parts were depleted to about half of their normal values. Similar trends were noted with the male pink salmon as well as with fish of both sexes in other species examined in this laboratory. The lateral dark muscle appears to be the main storage depot for fat, because its weight is much greater than that of the dorsal part. In the mature fish about ready to die, it seldom loses more than half of its oil, whereas the dorsal part loses nearly all of its oil.

Ash and Sodium Variations. The steaks, or cross-section slices are the parts used primarily as food. There was some variation in composition from nape to tail, but this variation was not pronounced except for the sodium content, which usually was about 15% less in the center than in the nape or tail parts (Table II). The sodium content appeared to be inversely proportional to the ash content, and the values were somewhat larger in the males than in the females. Ash values below 1.0% usually were accompanied by sodium values above 100 mg. per 100 grams of flesh. When the ash value was above 1.1%, the sodium value was usually below 75 mg. per 100 grams of flesh. The opposite trend was found with potassium, which was often inversely proportional to the sodium value and thus directly proportional to the ash value. The mineral content of fish flesh has been reported in considerable detail (*8*, *9*).

Protein and Potassium Variations. Potassium values showed a more uniform variation with protein content than with either sodium or ash contents (Table II). Except in the dorsal parts, the values were about the same for the two sexes. In most of the individual cases, potassium values of less than 300 mg. per 100 grams of flesh were found with a protein content of less than 19%. On

Table III. Composition of Fillets from Iced and Brine-Chilled Fish

Part	Moisture, % Av.	Moisture, % Range	Oil, % Av.	Oil, % Range	Protein, % Av.	Protein, % Range	Ash, % Av.	Ash, % Range	Sodium, Mg./100 Grams Av.	Sodium, Mg./100 Grams Range	Potassium, Mg./100 Grams Av.	Potassium, Mg./100 Grams Range
					8 days in ice							
Dorsal	57.5	49.9–65.0	31.7	23.8–39.6	11.5	11.1–11.8	0.6	0.6	62	44–79	110	108–112
Lateral	71.4	70.3–73.2	10.2	8.5–11.4	18.1	17.8–18.3	1.0	1.0–1.1	52	46–61	202	190–217
Belly flaps	75.8	74.1–77.6	6.8	4.4–9.1	17.7	16.9–18.4	0.7	0.6–0.7	53	45–60	104	82–125
Light meat	77.9	77.6–78.5	1.8	1.5–2.3	20.4	20.1–20.8	1.0	0.9–1.1	59	52–72	241	222–259
					14 days in ice							
Dorsal	59.4	56.6–62.1	21.7	20.1–23.9	15.2[a]	...	1.1	0.6–1.5	44	33–55	134	111–157
Lateral	72.4	70.6–74.2	10.1	8.2–11.7	17.3	17.1–17.5	1.0	0.9–1.0	52	42–60	170	150–187
Belly flaps	78.8	77.8–79.9	4.3	3.5–5.3	17.1	16.8–17.3	0.5	0.4–0.5	43	27–57	82	62–93
Light meat	79.3	78.6–79.7	1.3	1.1–1.6	19.6	19.2–20.2	0.9	0.8–0.9	54	42–66	182	174–192
					8 days in brine							
Dorsal[a]	70.2	...	18.0	...	9.8	...	1.8	...	608	...	65	...
Lateral	71.0	69.7–73.1	12.0	9.6–13.6	15.7	15.4–15.9	1.7	1.6–1.8	535	410–627	109	95–122
Belly flaps	80.7	77.8–83.2	4.9	3.2– 7.1	12.6	11.9–13.2	2.2	2.0–2.3	794	639–954	52	43–63
Light meat	78.4	78.0–78.9	1.5	1.3– 1.7	19.1	18.5–19.7	1.8	1.8–1.9	520	480–554	147	135–165
					8 days in brine followed by 6 days in ice							
Dorsal	54.1	47.3–60.9	29.4	22.0–38.0	13.9	12.6–15.8	0.8	0.6–0.9	232	172–271	60	56–69
Lateral	71.7	69.6–73.6	11.3	8.7–13.9	16.0	15.1–16.8	1.2	1.1–1.2	313	307–323	98	82–112
Belly flaps	79.5	77.6–81.0	5.9	5.0– 6.6	13.9	13.0–14.4	1.1	1.0–1.2	342	297–396	43	39–47
Light meat	79.0	78.9–79.1	1.8	1.8	18.7	18.4–18.9	1.4	1.4	379	358–407	104	93–110

[a] Only one value due to lack of sample.

the other hand, when the potassium value was above 300, the protein content was usually above 20%.

Mineral Content of Iced Fish. The eviscerated fish stored in ice had about the same variations in moisture (50 to 80%), oil (1 to 40%), and protein (11 to 21%) (Table III) as samples prepared from the fresh fish. This was not the case, however, for ash, sodium, and potassium. The ash decreased by 0.25, the sodium by 0.10, and the potassium by 0.5 of their initial values.

Mineral Content of Brine-Chilled Fish. The eviscerated fish that were stored first in brine and then in ice had about the same ranges in composition as had the iced samples for moisture (47 to 83%), oil (1.3 to 38%), and protein (12 to 20%) (Table III), but the ash and metal ion contents showed much greater variations. After storage of the fish in brine for 8 days, the ash content increased by half and the sodium content ninefold, but the potassium content decreased by more than half. Because the brine contained only sodium chloride, there could be no uptake of potassium. Much of its apparent loss could be due to the large uptake of sodium when calculated on a proportional basis. In the samples that were iced after brine storage, there was extensive leaching of all three constituents. The ash dropped by one fourth but was still higher than normal. About one third of the sodium leached out, but the value was still about five times the normal value found in fresh flesh. Potassium continued to decrease, and the drop was about the same as for sodium (0.33).

Organoleptic Changes. Differences in quality between iced and brine-chilled fish were small. No objectionable flavors were detected in the fillets cut from the brine-chilled fish. These fillets, however, did have a salty taste. The sodium content of the brine-stored samples was approximately that found in the commercially canned product. Although storage of fish in ice subsequent to brine-chilling leached out a large part of the absorbed sodium, the level was still several times that found in fresh fish. It is not known if this level of salt would be objectionable to the consumer of the fresh product. The producer who specializes in dietetic packs should be aware of the increased sodium content of brine-chilled fish. The quality of the brine-chilled fish does not appear to be affected adversely, except for the sodium uptake. The storage life of iced fish after brine chilling does not appear to be shortened by this method of chilling.

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CORRESPONDENCE

Endrin Content of Milk and Body Tissues of Dairy Cows Receiving Endrin Daily in Their Diet

SIR: Table VI in our article [J. AGR. FOOD CHEM. **6,** 518 (1958)] has been criticized for including data appearing to show relative safety margin—with respect to milk contamination—of endrin, toxaphene, and DDT applied to alfalfa. We concede that a better basis for comparison would have been the chronic oral toxicity to rats and that if this had been done, the relative safety margin, as we call it, would have shown much less spread among the three materials. The only purpose of the table was to illustrate some of the factors which would be considered when evaluating the residue hazard of a pesticide.

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