

STUDIES ON THE SALT CONCENTRATION OF
COMMERCIALY DRIED (TUYO) AND
SMOKED (TINAPA) HERRING

By V. UYENCO, P. RODRIGUEZ, and R. TARUC
of the Bureau of Fisheries, Manila

ONE TEXT FIGURE

INTRODUCTION

The Philippine fish production for 1949 was estimated at some 238,000,000 kilograms of fish. Ten per cent of this, or 23,800,000 kilograms, were processed and the rest sold fresh or iced. Of the processed fish, 70 per cent were dried and smoked, and the 30 per cent were manufactured into fermented products like fish paste (*bagoong*) and fish sauce (*patis*). The herrings form the bulk of our processed fish products as shown by the following data:

DRIED, SMOKED AND SALTED FISH	Per cent
Herring and allied species	52
Tuna, mackerel, and allied species	14
Jacks, pampanos, and allied species	6
Barracudas, mullets, and allied species	5
Mollusks (oysters, mussels, clams, scallops, cuttle fish, etc.	5
Crustaceans	4
Milkfish	2
Perches, croakers, breams, basses, and allied species	2
Teleostean fresh water species	1
Other Teleostean marine species	9
	100

Three species of herrings, *tunsoy* (*Sardinella fimbriata*), *lapad* (*S. perforata*), and *tamban* (*S. longiceps*), constitute 25 per cent of the total fish processed as dried and smoked. The first two species are made into *tuyo* or *tinapa* and the third one into *tinapa*. *Tuyo* (literally means dried) is the trade name for dried herrings, *tinapa* for the smoked. *Tuyo* is brine-salted in the round, and subsequently dried under the sun. In the preparation of *tinapa* the fish are dipped in boiling dilute brine for a few minutes and then subsequently smoked. These processed herrings bring in the sum of

3,600,000 pesos when sold in the retail market at an average cost of 60 centavos per kilo (1949). Martin(1) describes in detail the making of *tinapa* and Montalban(2) and Seale(3) discuss the preparation of *tuyo* in their papers published in the Philippine Journal of Science.

A survey of the *tuyo* found in the market reveals that it is too salty, so portions of the product served on the table are discarded as scraps. There is so much waste of fish and salt and the finished product is generally of poor quality. The dried fish are usually "burnt" and too blanched because of over-salting. The fish are not usually fresh at the time they are processed for they are caught too far away from the processing plants. This is particularly true with fish delivered in Manila, whereas dried fish coming from localities near the fishing grounds, especially in the Visayas are of better quality. The erroneous practice of over-salting to improve stale or slightly tainted fish cannot be over-emphasized.

We believe that there are other shortcomings which should be overcome, but for the present we are limiting our study to salt concentration of *tuyo* and *tinapa*.

EXPERIMENTAL METHOD

The *tuyo* and *tinapa* were bought from wholesalers in the city markets from September 1949 to July 1950. Lots of 25 to 50 pieces of fish were picked from the wholesaler's basket with the idea that such a number coming from a basket of 100 fish would constitute a homogeneous group that were processed together.

A panel of tasters was organized from the personnel of the Bureau of Fisheries. The usual consideration in organizing a panel was observed. Each lot of fish was divided into two portions, one for panel test and the other for analysis. For panel tasting, the fish were cooked the usual native way of serving *tuyo* and *tinapa*. The panel judged them into five degrees of saltiness.

The portions for analysis were scaled and only the edible flesh was taken and finely chopped to get a homogeneous sample of each lot. Moisture determination was done by using a vacuum oven maintained at 100°C. and evacuated to 25 lbs. reading in the vacuum gauge. Sodium chloride analysis was performed on the fresh and dried samples, using the "Open Carius Method" of the A.O.A.C. (1945 ed., par.

24.5). The results of the analysis were made to tally with the judgment of the panel.

RESULTS AND DISCUSSION

According to the panel test (Table 1), all samples of tuyo excepting one (DL-6) were over-salted while most of the tinapa had the right saltiness, 5 to 7 per cent fresh basis, or 12 to 18 per cent dry basis. For tuyo, only one sample came within the "just-right" grouping, and gave an analysis of 9.22 per cent fresh basis, so that a range for the right concentration of salt for tuyo could not be established. Because of this, we did our own salting to establish the desired range and also to determine the length of time of immersion using saturated brine that will give the desired salt concentration.

TABLE 1.—Moisture and sodium chloride analysis of dried (tuyo) and smoked herring (tinapa).

[D—Dried (tuyo); S—smoked (Tinapa); L—lapad; T—tunsoy. Example: DL-8 means dried 'lapad' lot 8; ST-9 means smoked 'tunsoy lot 9].

Panel test	Moisture		Sodium chloride			
	Tuyo	Tinapa	Tuyo		Tinapa	
			Fresh	H ₂ O free	Fresh	H ₂ O free
Rating	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Very salty	D -1	43.62	14.50	25.75		
	DT-7	47.70	12.72	24.41		
	DL-8	43.42	12.61	21.80		
	DT-9	47.56	12.02	22.14		
In between "very salty" and salty	DL-4	46.40	14.69	27.14		
	D -2	43.57	13.72	24.35		
	DL-5	39.89	13.24	22.37		
	DT-4	41.46	12.06	20.55		
Salty	DT-5	45.50	12.21	22.48		
	DL-3	41.48	11.70	20.43		
	S -2		52.69		10.40	22.01
In between salty and just-right	DT-8	41.77	11.87	20.51		
	DL-7	41.88	11.27	19.36		
	DT-6	47.04	7.78	14.72		
	SL-8		59.93		10.50	26.55
	S -1		51.64		9.40	19.49
	SL-3		57.21		9.36	21.87
Just right	DL-6	44.24	9.22	16.54		
	SL-4		55.30		7.31	16.35
	ST-8		63.81		6.93	18.81
	SL-7		57.16		6.69	15.62
	SL-6		64.64		6.48	18.36
	ST-5		59.30		6.41	15.74
Flat	SL-5		60.16		6.00	15.10
	ST-7		67.59		5.14	15.87
	ST-4		58.75		5.00	12.12

The fish we salted were about of the same size as the ones bought from the market. Saturated brine of Parañaque salt at room temperature was used throughout this work. This is the salt most processors use.

From Table 2 the "just-right" range for sodium chloride is from 8 to 10 per cent fresh basis, 11 to 14 per cent moisture-free basis. These samples falling under the "just-right" group, as judged by the panel, were immersed from 20 to 40 minutes. No wonder, most tuyo sold in the market are too salty, for the commercial practice is by immersion lasting from 3 to 5 hours and sometimes overnight. After an hour of immersion the fish have practically taken in the maximum amount of salt (see characteristic curves of salt absorption with respect to time; note the levelling off, after 60 minutes, fig. 1). The processors have no regard for the proper salt

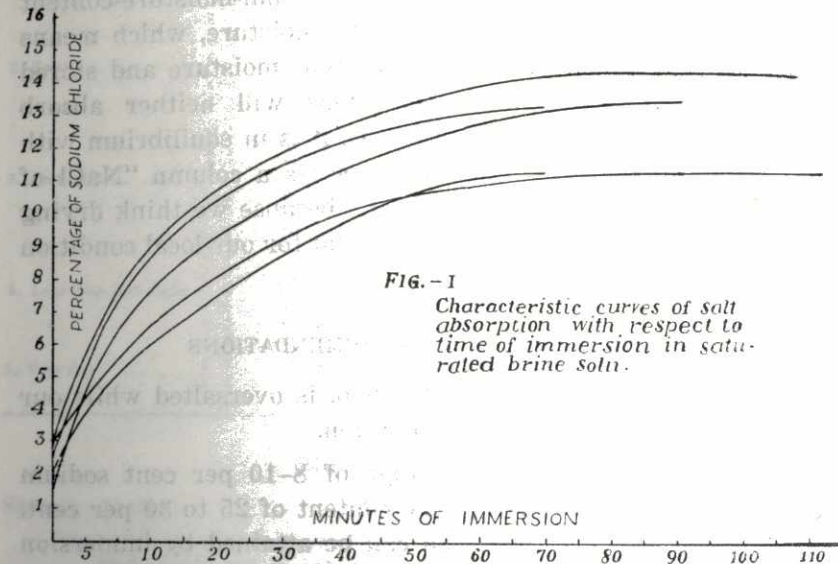


FIG.-1
Characteristic curves of salt absorption with respect to time of immersion in saturated brine salt.

concentration. They substitute immersion in brine for cold storage to preserve their stock of fish and because the fish are tainted most often, they intentionally oversalt them. Over-salting does not improve the quality of processed fish nor can it restore freshness to stale fish. The quality of a processed fish can only be as good as at the time it was processed. Drying is the better way of preserving compared to salting. (Take note from Tables 1 and 2, "just-right" grouping that on the basis of salt per weight of tissue (H₂O-free basis tinapa has more salt than tuyo and yet tinapa keeps for a very much shorter time than tuyo.) Salting alone without the accompanying reduction in moisture content of fish does not prevent chemical changes. A good example of this is "bagoong" and "patis" processing.

The question is often asked. What is the best moisture content for tuyo or, for that matter, all dried fish under local conditions? Our observations and experience on the processing of dried fish place it between 25 to 30 per cent moisture during dry season (December–April) and 30 to 35 per cent during wet season. The drier the product the better it keeps, however, due to the high humidity in the atmosphere, moisture content lower than the ranges given above is not practicable, and even granting that a product is dried lower than 30 per cent moisture, it will reabsorb some moisture from the air on standing. The equilibrium-moisture-content of our salted fish is around 35 per cent moisture, which means that our salted fish containing 35 per cent moisture and stored under our local atmospheric conditions will neither absorb nor give up moisture. In other words, it is in equilibrium with water vapor of our air. Table 2 presents a column "NaCl of Sample Adjusted to 35 per cent H₂O," because we think drying to 35 per cent moisture is the most logical for our local condition of relatively high humidity.

CONCLUSIONS AND RECOMMENDATIONS

1. Our commercial fish product, tuyo, is oversalted while our tinapa has the right salt concentration.

2. A good tuyo will have a range of 8–10 per cent sodium chloride fresh basis with moisture content of 25 to 30 per cent. This desirable salt concentration can be attained by immersion in saturated brine at room temperature from 30 to 40 minutes. These conditions will hold good for our ordinary sizes of herrings.

3. Salt concentration greater than what is recommended will not lengthen keeping time for the slight increase of salt over the desirable range will not make the products keep longer. It is the amount of moisture in the tissue which determines the keeping time.

4. If processors will cut their brining time to 30–40 minutes, they will be saving some 250,000 pesos worth of fish alone, not counting the loss in extra materials and time, and also the increase in price rightly salted tuyo will command.

TABLE 2.—Dried herring (tuyo)
[Numbers before letter B stands for minutes of immersion; those after letter B stands for batch number. Thus 50 B-10 means sample of batch 10 immersed for 50 minutes]

Panel rating	Sample No.	Moisture	Sodium chloride		NaCl of sample adjusted to 35% H ₂ O
			Fresh basis	Moisture free	
			<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
1. Very Salty	70 B-12	24.95	16.37	22.51	14.62
	55 B-12	23.12	14.81	19.23	12.50
	90 B-12	23.62	13.57	17.87	11.62
	55 B-11	21.18	13.27	16.97	11.03
	60 B-12	22.90	12.72	16.07	10.45
	60 B-11	21.47	12.71	16.39	10.66
	80 B-12	26.55	12.60	17.02	11.07
	50 B-10	29.38	11.31	15.88	10.32
	55 B-10	28.78	10.88	15.27	9.93
	60 B-10	30.69	10.72	15.54	10.10
	60 B-12	24.46	10.34	13.44	8.73
2. Salty	40 B-11	23.87	12.21	16.15	10.50
	45 B-11	21.13	11.77	15.03	9.77
	50 B-11	22.72	11.50	14.58	9.48
	45 B-12	26.02	10.83	14.62	9.48
3. Just right	20 B-11	22.25	10.53	14.03	9.12
	40 B-12	27.58	9.80	13.76	8.95
	30 B-11	22.44	9.80	12.79	8.31
	30 B-12	28.29	9.61	13.83	8.99
	45 B-10	29.15	8.61	12.50	8.13
	30 B-10	28.63	8.43	12.21	7.93
	40 B-10	28.70	8.13	10.68	6.94
	20 B-12	30.28	8.13	11.49	7.47
4. Less than just right	10 B-11	22.31	8.40	10.99	7.15
	10 B-12	29.85	7.12	10.18	6.62
	20 B-10	27.49	6.49	8.93	5.81
	10 B-10	25.16	5.81	7.83	4.96
5. Very flat	0 B-10	21.32	2.64	3.07	2.00
	0 B-11	16.63	2.26	2.69	1.75
	0 B-12	24.35	1.61	2.09	1.36

REFERENCES CITED

- SEALES, ALVIN.
Preservation of commercial fish and fishery products in the tropics. Phil. Jour. Sci. 9 (1914).
- MONTALBAN, HERACLIO R.
Investigation on fish preservation conducted at Estancia, Panay, Philippine Islands. Phil. Jour. Sci. 42 (1930) 309–335.
- MARTIN, CLARO.
Methods of smoking fish around Manila Bay. Phil. Jour. Sci. 55 (1934) 79–89.

ILLUSTRATION

TEXT FIGURE

FIG. 1. Characteristic curves of salt absorption with respect to time of immersion in saturated brine solution.