E VALUE RATIOS FOR GRAYFISH, SOUPFIN SHARK, SABLEFISH, AND HALIBUT LIVER OILS PRODUCED IN THE PACIFIC NORTHWEST

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ABSTRACT

Ratios of the amount of light absorbed at the wave lengths 300, 328, and 350mmu. by vitamin A in several species of fish liver oils were investigated. The average values of these ratios, the variation to be found, and the maximum and minimum values to be expected on a probability basis are given.

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INTRODUCTION

Through the cooperation of the Pacific Northwest vitamin A processors, E value ratios for a substantial number of commercial batches of grayfish, soupfin shark, sablefish, and halibut liver oils have been made available to the Seattle Technological Laboratory. The data were taken over a number of years, and they are representative of a large tonnage of livers.

Ratios are used to evaluate the results obtained by the spectophotometric method of vitamin A analysis. Since this method is widely employed, and since the bulk of the vitamin A oils produced in the United States are of the four types here considered, these data are believed to be important.

Two ratios were investigated. These are E(300mmu.)/E(328mmu.) and E(350mmu.)/E(328mmu.). The purpose of this paper is to give the average values of these ratios, the variation to be found, and the maximum and minimum values to be expected on a probability basis.

Table 1 - Data on the Ratio E(300mmu.)/E(328mmu.)[1]

Type of oil[2]	Number of samples[3]	Average value of ratio	Standard deviation	Coefficient of variation	Range in which 95% of the ratios are expected to fall	Range in which 99% of the ratios are expected to fall[4]
	n	$\bar{x}$	s	$100s/\bar{x}$	$\bar{x} \pm 1.96s$	$\bar{x} \pm 2.571s$
Grayfish (Squalus suckleyi)	35	0.6673	0.0355	5.32	0.5977-0.7369	0.5760-0.7586
Soupfin shark (Galeorhinus zyopterus)	107	0.6651	0.0275	4.13	0.6112-0.7190	0.5944-0.7358
Sablefish (Anoplopoma fimbria)	30	0.6086	0.0199	3.27	0.5696-0.6476	0.5574-0.6598
Halibut (Hippoglossus hippoglossus)	89	0.5968	0.0185	3.10	0.5605-0.6331	0.5492-0.6444

1/ These data were taken by means of the Beckman spectrophotometer employing a tungsten light source. The slit widths were not standardized. The solvent used was isopropanol.
2/ The manufacturers stated that to the best of their knowledge the oils were not mixtures and that they were representative of commercial oil shipments from the Pacific Northwest.
3/ The grayfish data were taken during the year 1947. The soupfin shark, sablefish, and halibut data were taken in the years 1944-47. The data for each type of fish are representative of many tons of livers.
4/ The mere fact that the ratios for an oil fall within a given range is no guarantee that the oil is of a given type or even that it contains vitamin A. Conversely, the fact that the ratios do not fall within the specified range is no proof that the oil is not of the type claimed. It must be remembered that these are the variations encountered in the Pacific Northwest with large lots of oils. Smaller lots or oils processed elsewhere may not exhibit the same variation. The data do give a good indication, however, of what should reasonably be expected.

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OBSERVATION ON E VALUE RATIOS DATA

Table 2 - Statistics on the Comparison of Means for the Ratio E300mmu. to E328mmu. and their Interpretation

Oils whose means are compared	Degrees of freedom	"Student's" t	Probability	Significance of difference between means
Grayfish and soupfin shark ...	140	0.38	0.70	not significant
Grayfish and sablefish	63	8.02	less than 0.001	highly significant
Grayfish and halibut	122	14.42	less than 0.001	very highly significant
Soupfin shark and sablefish ..	135	10.52	less than 0.001	very highly significant
Soupfin shark and halibut	194	20.00	less than 0.001	very highly significant
Sablefish and halibut	117	2.96	$0.001 < P < 0.01$	significant

The average values of the ratios are given in Tables 1 and 3 as are also their coefficients of variation. In the case of a natural product, such as a fish liver oil, one might anticipate that its properties would be widely variable. In view of this probable variation, the compiled data show that the individual ratios are surprisingly constant. The maximum coefficient of variation found for any one of them is only 5.32 percent. This value is of the same order of magnitude as the instrumental error in making the measurements. It can be noted that, in the case of

Table 3 - Data on the Ratio E350mmu. to E328mmu.

Type of oil	Number of samples	Average value of ratio	Standard deviation	Coefficient of variation	Range in which 95% of the ratios are expected to fall	Range in which 99% of the ratios are expected to fall
	n	$\bar{x}$	s	$100s/\bar{x}$	$\bar{x} \pm 1.96s$	$\bar{x} \pm 2.571s$
Grayfish	35	0.5815	0.0157	2.70	0.5507-0.6123	0.5411-0.6219
Soupfin shark	107	0.5696	0.0089	1.56	0.5522-0.5870	0.5467-0.5925
Sablefish	30	0.6415	0.0246	3.83	0.5933-0.6897	0.5783-0.7047
Halibut	89	0.6600	0.0202	3.06	0.6204-0.6996	0.6081-0.7119

the shark oils, the greatest variation is in the E(300mmu.)/E(328mmu.) ratio, while in the case of the food fishes, the greatest variation is in the E(350mmu.)/E(328mmu.) ratio. It is also interesting to note that the average values of the E(300mmu.)/E(328mmu.) ratio are similar for the oils from the two species of shark and that they are higher than the ratios for the oils from the food fish, while the converse is true for the E(350mmu.)/E(328mmu.) ratio. Another observation is that even at the 99 percent level, the ranges for the E(350mmu.)/E(328mmu.) ratios of the oils from the soupfin shark and halibut do not overlap.

A statistical analysis (Tables 2 and 4) of the data shows that, except for the ratios E(300mmu.)/E(328mmu.) for grayfish and soupfin shark, all other ratios presented here differ significantly.

Table 4 - Statistics on the Comparison of Means for the Ratio E350mmu. to E328mmu. and their Interpretation

Oils whose means are compared	Degrees of freedom	"Student's" t	Probability	Significance of difference between means
Grayfish and soupfin shark ..	140	5.61	less than 0.001	highly significant
Grayfish and sablefish	63	14.23	less than 0.001	very highly significant
Grayfish and halibut	122	24.10	less than 0.001	very highly significant
Soupfin shark and sablefish .	135	25.78	less than 0.001	very highly significant
Soupfin shark and halibut ...	194	41.73	less than 0.001	very highly significant
Sablefish and halibut	117	4.10	less than 0.001	highly significant