In the next time, there is a considerable metabolic change through larval stage. A young salmon just absorbed its yolk-sac gains 85 mg. in weight as the result on absorbing 117 mg. of water and consuming 35 mg. of solids.

At any rate, the growth phenomenon through egg and larval stages are consumption of the greater part of the organic matters in them and the assimilation of some mineral matters and large amount of water from the surrounding medium, because several newly constituents as phospholipins or proteins of muscles and etc., are synthesized from the materials contain originally in this organism.

BIOCHEMICAL STUDIES ON *SALMONIDAE* II.

ON THE DEFECTS OF SILKWORM'S PUPAE AS FOOD OF YOUNG TROUTS (*SALMO IRIDEUS*.)

By

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This paper reports the study on the nutritive value of silkworm's pupae which utilized largely as food for feeding fishes in this country.

The feeding experiments were carried out for 63 days, from July 28 th., to September 28 th., 1927, at The Fish Culture Station by the Lake of Kizaki, Nagano Prefecture.

The experimental animals—young rainbow trouts 180mg. in weight—were divided into 3 groups each of which has 300 fishes. The first group were fed on a basal ration which consisted principally powdered pupa mixing starch of 20%. The second group were supplied the above ration with addition of Osborne's salt mixture and some raw fish, and the diet for the third was that which was added the salt mixture and a small amount of cod liver oil, rice bran and a juice of radish as sources of vitamins A, B and C on the basal one.

The results of the feeding experiments:— All of them are summarized in the Table I and II.

Table I.

Number of fishes		Group I		Group II		Group III	
Opening	300	%	300	%	300	%	
Ending	19	6.3	14	4.7	115	38.3	
Loss	281	93.7	286	95.3	186	61.7	
Dead	198	64.3	282	94.0	157	52.3	
Missing	88	29.3	4	1.3	28	9.3	

Table II. The total weights of the fishes in each group on the opening and on the ending of the experiments.

	Group I	Group II	Group III
Opening (g.)	54	52	56
Ending	25	17	80
Per cent	46	33	143

In view of these results, the survived animals in the first group were only 6 % in number and 46 % in weight, and 70 % of the loss in the former case were dead while the others were missing. The remainders in the second group were 5 % and 33 %, and the majorities (90 % in number) of which died away at early period of the feeding and the missings, therefore, were very few. But 40 % of the third group were survived and gained 43 % in weight. This good figures in the last case should probably resulted by the addition of the vitamins.

The analytical results :— The results of chemical analysis of the survived animals in each group show in the Table III and IV.

Table III. Individual chemical composition of 3 samples in each group.

		Live weight	Water	Solids	Inorg. matter	Organic matter	Lipins	Nitrogen
Group I	A	1540	1205	335	23.3	311.6	76.6	37.74
		100	79.25	21.75	1.52	20.23	4.97	2.451
				100.00	6.97	93.03	22.88	11.27
"	B	1310	1023	287	17.9	269.0	67.1	31.57
		100	78.09	21.91	1.37	20.54	5.12	2.41
				100.00	6.24	93.76	23.38	11.10
"	C	740	597.5	142.5	8.08	134.4	27.2	15.9
		100	80.77	19.23	1.09	18.14	3.68	2.149
				100.00	5.68	94.32	19.12	11.18
Group II	D	1400	1082	318	12.01	306.0	67.4	35.62
		100	77.25	22.72	1.91	20.31	4.82	2.559
				100.00	8.55	91.45	21.19	10.52
"	E	1030	870	163	9.36	153.6	19.1	19.36
		100	83.25	16.75	1.52	15.23	1.85	18.81
				100.00	9.09	90.91	11.38	11.23
"	F	750	586	164	6.20	158.8	40.0	18.01
		100	78.09	21.91	1.81	20.10	5.33	2.402

				100.00	8.27	91.73	24.35	10.96
Group III	G	1420	1132	288	21.0	267.0	61.1	27.83
		100	79.72	20.28	1.48	18.80	4.31	2.199
				100.00	7.30	92.70	21.26	10.84
"	II	1330	1040	290	22.67	267.3	63.5	31.73
		100	78.16	21.84	1.70	20.14	4.77	2.385
				100.00	7.80	92.20	22.38	10.92
"	I	1040	829	221	18.39	202.6	44.4	21.01
		100	79.68	20.32	1.77	18.55	4.27	2.036
				100.00	8.70	91.30	21.01	10.02

Table IV. Average compositions of the remainders in each group.

	Solids	Inorg. matter	Organic matter	Lipins	Nitrogen
Group I	201.9	5.97	94.03	20.78	10.75
Group II	197.2	8.12	91.88	19.68	10.65
Group III	214.6	7.97	92.03	21.95	10.50

From these results, compositions of animals which fed on the same diet are not always equal but inorganic contents of the animals in the first group are surely less than those in the others. It may be probably seen that the difference comes from whether the salt mixture added to the basal diet or not.

Furthermore, the chemical composition of rainbow trout just absorbed their yolk-sacs (hatched out in the Atkin's method) at the Lake of Numazawa are as follows :-

Table V.

Live weight	Solids	Inorganic matter	Organic matter	Lipins	Nitrogen
150.0	26.67	1.85	24.82	3.87	3.255
100.0	17.68	1.23	16.46	2.58	2.17
	100.0	6.94	95.06	14.57	12.30

Comparing the animals employed for the experiments with the above sample, those in the first group of the former are poorer but the others are richer in the inorganic contents of dry matter per cent than the latter because the diet of the first group contains no salt mixture and the others contain it. The basal diet, therefore, should be lacked in this constituents. And we may be pointed out that the experimented animals are, in generally, poorer in proteins and richcher in lipins than the original ones. From these facts, it should be assumed that the protein of the dry pupa is poor in nutrition and its lipins are surplus for want of fishes.

Conclusion

Silkworm's pupa lacks in inorgnic and vitamins contents as a food of young trouts and their protein show low value in nutrition and their lipins contents are surplus for want of the fishes.

The missings in feeding animals which fed on a food lacking in vitamins like dry silkworm's pupae should be get rid off by means of adding these factors.

BIOCHEMICAL STUDIES ON *SALMONIDAE* III. ON THE NUTRITIVE VALUES OF FOODS MADE FROM FISHES.

By

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The feeding experiments carried out for 38 days, from May 24th. to June 30 th., in the hatching boxes through which containing always about 40 litres of running spring water, at The Kamaishi Hatchery in Iwate Prefecture.

The eggs of the experimental animals *Oncorhynchus Keta* (Walbaum) employed fertilized on December 27 th., 1926, hatched out on about February 29 th., 1927, and absorbed their yolk-sacs on May 24 th.

1500 young salmons were divided into 5 groups which were fed on the following diets :—

The first group ; no feed ; as blank.

The second group ; pasted, boiled rice polished.

The third group ; boiled, pressed and dried fish except its meat.

The fourth group ; boiled, pressed and dried fish.

The fifth groups ; unboiled fish, except its head and inner organs.

The date from the experiments are summarized as follows :—

TABLE I.

	Group I		II		III		IV		V	
<i>Total live weight and number.</i>										
Initial live wts(g.) & numbers.	92.25	300	90.75	300	97.35	300	97.35	300	97.52	300
Live wts & numbers on the end.	34.50	121	19.13	68	80.25	154	166.88	186	313.50	292
Percentage	37.22	40	21.08	23	85.63	51	171.4	62	321.5	973
Percentages of group II—V to group I	100		55.4		232.6		486.0		908.9	
<i>Values per fish.</i>										
Initial live weight (mg.)	308.8		302.5		312.5		324.5		325.1	
Live weight on the end.	285.1		281.2		521.1		824.5		1074.0	
Percentage	92.34		92.96		170.4		276.5		333.6	
Percentages of group II—V to group I.	100		98.63		186.8		314.7		376.8	