

SUMMARY.

The following conclusions have been reached :—

(1.) The south-western extremity of the North Island of New Zealand is probably a horst isolated by subsidence of land blocks on the west and on the south, and possibly on the east also.

(2.) The drainage-system has been developed by normal processes during a long period of elevation punctuated by pauses, the amount of elevation being at least 800 ft., and probably more.

(3.) The nature of the longitudinal drainage suggests that adjustment to structure was established in an earlier erosion period.

(4.) A prominent feature, Port Nicholson, has been produced by the subsidence of a block along lines which, with one notable exception, have not been clearly recognized.

(5.) This exception is the line of the Wellington fault, along which fault-scarp topography is well developed.

(6.) Recent changes of drainage have had the effect of destroying, rather than completing, previous adjustment to structure.

(7.) This is attributable to the activity of transverse streams on and near to fault-scarps.

ART. XXVIII.—*The Composition of some New Zealand Foodstuffs.*

By JOHN MALCOLM, M.D., Physiology Department, University of Otago.

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I. OYSTERS FROM STEWART ISLAND.

MOST of the oysters consumed in New Zealand come from the Bluff and Stewart Island. Owing to their comparatively large size, their pleasant flavour, and moderate price they form a much-prized addition to the dietary of all classes. So far as the writer knows, no analyses of these oysters have been published hitherto.

The samples examined were procured from a fishmonger in the usual way, and were then probably not more than three days out of the sea. The analysis was begun forthwith, care being taken in opening the oysters not to allow particles of the shell to mix with the contents. The amount of sea-water and other fluid obtained on opening and draining the oysters amounted to about 3 c.c. each, a quantity, however, which depends on the time elapsing between opening and draining. As the animal dies it undergoes rigor mortis, or some analogous change, with the result that more fluid can be drained off; if heated even slightly the amount is still more increased. In the samples analysed the opened oysters were immediately drained under light pressure in a cheese-cloth, then minced, dried, ground in a coffee-mill, and preserved in powder form.

Methods.

Glycogen was estimated in the fresh material by Pfluger's method—*i.e.*, the weighed sample was heated with strong KOH on the boiling-

water bath for three hours; the glycogen was then precipitated with alcohol, washed, and converted into glucose, which was estimated by Fehling's method.

Fat was estimated by Rosenberg's method—*i.e.*, extraction of the dried material with boiling absolute alcohol and chloroform alternately, with subsequent ether extraction of the material so obtained.

Protein was calculated from the amount of nitrogen on the assumption that the nitrogen formed 16 per cent. of the molecule. It was recognized, of course, that all the nitrogen present was not in the form of protein—in fact, oysters owe much of their value in dietetics to the presence of nitrogenous extractives; on the other hand, they contain much nucleo-protein, or a similar body rich in phosphorus, in which the nitrogen must be under 16 per cent.

Ash or mineral matter was estimated by incineration, aided by extraction with hot distilled water and subsequent evaporation of the extract.

The results are given in Tables I and II.

Table I.—Composition of Stewart Island Oysters.

	I. May 24.	II. May 25.	III. May 31.	IV. Oct. 31.
Edible matter per oyster	12 g.	9 g.	11.5 g.	8.6 g.
Dried solids per oyster		2.5 g.	2.24 g.	1.8 g.
Water, per cent.		75.8	75.2	78.8
Solids, per cent. (by difference)		24.2	24.8	21.2
Glycogen, per cent.	3.36		3.74	0.5
Protein, per cent. ($N \times 6.25$)		12.20	13.72	12.72
Fat, per cent.		3.66	3.47	1.83
Salts, per cent.		2.34	2.71	2.43
Percentage unaccounted-for (assuming that II had same glycogen per cent. as I)		2.37	1.16	3.72

In the above table it may be observed that samples I, II, and III were obtained early in the season, sample IV at the end, and on comparing these it is evident that a marked deterioration of the oyster occurs by the end of the season: it becomes more watery, glycogen drops to one-seventh of its initial value, the fat diminishes to nearly half, and the extractives are relatively increased. It would be interesting scientifically, and would throw a valuable light on what ought to be the limits of the oyster season in New Zealand, if analyses were made at regular and frequent intervals throughout the year.

Table II.—Comparison of Percentage Composition of Dried Solids

	II.	III.	IV.	American Oysters.*
Protein	50.51	55.56	60.00	52.13
Glycogen	15.00	15.00	2.35	28.20
Fat	15.14	14.01	8.64	11.96
Salts	9.67	10.94	11.47	16.23

From Table II it will be seen that at their best the New Zealand oysters contain much less glycogen and relatively more fat than the average American oyster.

* Calculated from an analysis by Langworthy quoted in Hutchison's "Food and Dietetics."

Qualitative Examination.

Protein.—As already mentioned, oysters contain a large amount of nucleo-protein or similar body rich in phosphorus. Besides this a saline extract of oysters contains a protein which coagulates about 75° C.

Fat and Pigment.—To the naked eye the ethereal extract of dried oysters appears brown, as is generally the case with fats dried at high temperatures. On spectroscopic examination this ethereal solution shows a distinct absorption band near the red end of the spectrum—apparently nearer that end than the characteristic band of methaemoglobin; on dilution the band approaches and fuses with the infra-red part of the spectrum. It is probably a lipochrome, as it is absent from watery extracts, and occurs only in extracts made by solvents of fat (ether, chloroform, acetone, alcohol, amyl alcohol, &c.). It was found in all the samples examined.

II. FROSTFISH (*Lepidopus caudatus*).

This peculiar-looking fish, known in other parts of the English-speaking world as “scabbard-fish,” is found in the Mediterranean and warmer parts of the Atlantic as well as around the Tasmanian and New Zealand coasts. It derives its popular name from the fact that it is thrown up by the sea in frosty weather, and is found dead or dying on the beach. According to one view, it comes ashore voluntarily, as if bent on self-immolation; it has seldom, if ever, been caught alive, and is generally believed to be a deep-water fish. In shape it is long and ribbon-like, and has a bright scaleless skin. Unlike many New Zealand food fishes, it has a distinctive flavour, and partly from this and partly no doubt, from its comparative rarity it is regarded as a delicacy, and sells at 1s. 6d. to 3s. per pound. For the purposes of sale and for cooking it is cut into slices across its long axis; all such outlets include the vertebral column, and some also include the abdominal cavity. There is a considerable amount of waste matter in the outlets; thus in an ordinary slice as bought only 85 grm. out of a total of 134 grm. consisted of edible flesh. The residue (36·5 per cent.) consisted of bone, skin, and tough intermuscular septa, although the latter would probably form gelatine during the process of cooking, and should not be considered altogether as waste.

Fat.—The flesh is obviously fatty, and an oily scum forms on the water in which it is boiled; but the fat is unequally distributed, there being much more in the tissues immediately surrounding the abdominal cavity than in the muscles of the sides. In the first sample examined the fat of the dorsal portion or sides of the fish amounted to 4·55 per cent., and that of the ventral to 16·77 per cent. In the second sample there was 7·36 per cent. fat in the sides, and 20 per cent. in the ventral portion. From the culinary point of view, therefore, the frostfish should be reckoned as a fatty fish somewhat akin to turbot. The fat extracted by ether is a yellow-coloured oil, half-fluid at room-temperature, and possessing a smell which recalls that of cod-liver oil. It contains 1 per cent. of nitrogen.

Protein.—Owing to the presence of a considerable amount of non-protein nitrogenous substance, it is not permissible in this case to use the total nitrogen as the basis for calculating the percentage of protein. The following procedure was therefore followed: The residue, after extraction of the fat, &c., by chloroform and alcohol, was weighed and sampled for nitrogen-estimation—thus 10·967 grm. partly dried “sides”

of fish, representing 37.45 grm. fresh material, was extracted with chloroform and with alcohol; the residue weighed 8.412 grm.; the nitrogen percentage of this was 12.56, which equals 2.807 per cent. of protein-nitrogen in the moist fish, or 17.54 per cent. protein. The total nitrogen of the moist frostfish was found to be 3.6 per cent. Deducting the protein-nitrogen (2.8 per cent.) we obtain 0.8 per cent. of nitrogen belonging to non-protein material. As already stated, the ether-soluble "fat" contains 1 per cent., but even after deducting this value (0.08) we have 0.72 per cent. nitrogen to account for, and, as will be mentioned later, this nitrogen was partly present in a special crystalline substance soluble in alcohol.

Glycogen could not be detected in the samples of frostfish examined; thus 30 grm. was treated by Pflüger's method without positive result.

The main points brought out by the analysis are shown in the following table:—

Table III.—Composition of Frostfish. (Flesh of "sides" or dorsal portion only.)

	Sample 1.	Sample 2.
Water, per cent.	76.8	73.5
Solids, per cent.	23.2	26.5
Fat, per cent.	4.55	7.36
Total nitrogen, per cent.	2.82	3.6
Protein, per cent.	Under 17.6	17.54
Glycogen	...	Nil.
Alcoholic extract, per cent.	...	0.8
Ash, per cent.	1.15	1.28

The data obtained from analysis of the ventral part of the fish are as follows:—

Sample 1.—Fat, 16.77 per cent.; substances soluble in boiling water (gelatine and salts), 3.7 per cent.; substances insoluble in boiling water (coagulated proteins, &c.), 2.73 per cent. The water percentage was not estimated. These figures are calculated on the assumption that it was the same as in the other parts of the fish.

Sample 2.—24.8 grm. ventral portion of frostfish gave 4.9584 grm. ether-soluble fat = 20 per cent.

Crystalline Substance.—On boiling fresh minced frostfish with 96 per cent. alcohol, and allowing the extract to cool, a fine white crystalline deposit formed. Under the microscope two types of crystals appeared to be present; the more numerous were balls of fine, pointed needles slightly bent or twisted so that they resembled puff-balls, the others were much smaller rounded clumps of indeterminate crystalline matter. At first sight they might be mistaken for leucin and tyrosin. When filtered and allowed to dry in the air the deposit formed a white powder, easily soluble in water. It gave no biuret or Millon's reaction, and did not reduce Fehling's solution. Ammonia caused a slight precipitate. When directly tested the powder gave distinct evidence of carbon, nitrogen, and phosphorus.

While frostfish is undoubtedly of high nutritive value, and an excellent article of diet, the conditions under which the fish is obtained, its doubtful degree of freshness, its high percentage of fat which from its oily nature is apt to become rancid, the presence of a special alcohol-soluble substance at present of unknown nature, all tend to make one careful in advising its use for invalids. Parasitic worms—small, round,

and coiled like a watch-spring—occur fairly often; they are probably quite harmless.

III. KUMARA, OR SWEET POTATO.

The kumara, or Maori sweet potato, is cultivated to a considerable extent in the North Island of New Zealand. It seems to be the same as the sweet potato of America and the Pacific islands generally, but some slight differences in the composition were found, and these deserve to be put on record. No complete detailed analysis was made.

Carbohydrate.—Starch, in the form of granules which present the usual appearance of batata-starch, constitutes the most important of the solids. On hydrolysis it yields a dextro-rotatory reducing-sugar.

Dextrin.—Fresh kumaras were extracted first with absolute alcohol to remove sugar and other substances, then with cold water after driving off the traces of alcohol. On adding alcohol this yielded a flocculent precipitate when the alcohol present amounted to 60 per cent. This precipitate was separated out and dissolved in water. It gave reactions corresponding to those of a dextrin—viz., no reduction till after hydrolysis—and with iodine a dull-violet colour.

Cane Sugar (?).—An alcoholic extract of kumaras contains all the reducing-sugar present. If a watery solution of these sugars be hydrolysed the reducing-power is markedly increased. Thus in two separate samples the increase in reducing-power on hydrolysis indicated that 63·6 per cent. of the sugar was in this form.

Monosaccharide (?).—A fresh watery extract of kumaras always shows reduction. If left lying in the laboratory for a few weeks the kumaras tend to grow mouldy, probably due to the sugars present, and the amount of sugar of both kinds shows a slight increase (0·11 per cent. in seventeen days in one case). In the process of drying minced kumaras to produce a powder for analysis there seems to be an increase in the amount of sugar formed. If the drying is done on a water bath where steam can reach the material, it forms gum-like masses, due to dextrin-formation, so that for analytical purposes drying is best done in an oven.

Protein.—The amount of protein is comparatively small, being at most not more than 3 per cent., as indicated by the total nitrogen. An estimation of the nitrogen in the flocculent precipitate obtained on boiling a cold-water extract of kumaras indicated less than 1 per cent. protein.

Fat.—The ether-soluble substances form a very small percentage of the solids (0·27 per cent.). They resemble resins or oleo-resins more than true fats, and it seems to be to these that kumaras owe their flavour.

Ash.—The ash contains calcium, iron, magnesium, and phosphoric anhydride.

The following table gives the main points examined:—

Table IV.—Composition of Kumara.

	Sample 1.	Sample 2.	Sample 3.	American.	
Water, per cent.	68·44	67·7	77·35	69·0	
Solids (by difference), per cent.	31·56	32·3	22·65	31·0	
Starch, per cent.	} 24·84 {	}	3·78	} 26·2	
Cane sugar, per cent.					
Monosaccharide, per cent.			2·7		2·17
Protein, per cent.	1·71	2·84	1·73	1·3	
Fat, per cent.	0·27			0·6	
Ash, per cent.	1·05			0·8	