

NUTRIENT CONTENTS IN NORWEGIAN FROZEN FISH PRODUCTS PROTEIN, FAT AND B-VITAMINS

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ABSTRACT

Thirtyone frozen fish fillets and fish products available on the Norwegian market were analysed for their contents of water, protein, fat, carbohydrate, ash, energy, thiamin, riboflavin, niacin, pantothenic acid, biotin and vitamin B₁₂.

The results for B-vitamins were discussed relative to the recommended daily allowances (RDA). The daily intakes of thiamine, riboflavin, niacin, pantothenic acid and biotin covered with a few exceptions 1 to 20 % of the RDA-values in the suggested portion sizes. Fish products were considered very good sources of vitamin B₁₂.

INTRODUCTION

Traditionally, fish and fish products have been consumed either fresh or preserved by canning, drying or salting. However, the use of frozen fish products has grown considerably during the latter decades. Further, a variety of new types of frozen fish products have been brought into the food market.

While the nutrient contents of traditional Norwegian fish food products are well known (Taarland et al., 1958), very few data are available on these new type of products. To evaluate the nutrient contents of such products, an extensive analysis was carried out with 31 different products on their contents of protein, fat, B-vitamins and major and minor elements.

This first paper from the study gives data for the contents of water, protein, fat, ash, carbohydrates, thiamine, riboflavin, niacin, pantothenic acid, biotin and vitamin B₁₂, and evaluate the intake of vitamins relative to accepted recommended daily allowances (RDA-values). A subsequent paper present corresponding results on the contents of major and minor elements in the products (Julshamn and Lied, 1986).

MATERIALS AND METHODS

Samples were obtained from the stock of the two main producers of frozen fish products in Norway. Each sample was represented by at least 10 portions and at least 5 kg pooled into one sample, from which samples were taken for freeze drying and further analysis.

Protein was determined as $N \times 6.25$ as described by Crooke and Simpson (1971). Fat was determined by Soxhlet extraction with diethyl ether followed by weighing the fat fraction.

Water was determined by drying at 105°C for 24 hrs., and ash was determined by ashing at 600°C for 24 hrs. The content of carbohydrate was calculated by difference, and net energy content calculated by applying the factors 4.0 kcal/g for protein and carbohydrate and 9.0 kcal/g for fat.

All vitamins were determined by microbiological growth assays. Thiamine was determined with *Lactobacillus viridescens* (ATCC 12706) according to Deibel et al. (1957), riboflavine was determined with *Leuconostoc mesenteroides* (ATCC 10100) according to Barton-Wright (1963), niacin and pantothenic acid were determined with *Lactobacillus plantarum* (ATACC 8014) according to AOAC Methods (1980), biotin was determined with *Lactobacillus plantarum* according to Pharmacopoea Nordica (1960) and B₁₂ with *Leuconostoc mesenteroides* (ATCC 4797) using an assay growth medium from Ferrosan, Denmark.

RESULTS AND DISCUSSION

The contents of water, protein, fat, carbohydrate, ash and energy, and ratios of protein energy, fat energy and carbohydrate energy are given in Table 1.

The water content of the products averaged 73.6%. The energy content of the products varied between 549 and 2037 kcal/kg. In breaded products except precooked fish fingers the energy content was distributed mainly between protein and carbohydrate, with fat energy values varying from 0 to 16%, averaging 3.7%. Precooking of fish fingers added a substantial amount of fat to the products. In four of the products (fish cakes, fish soup, fish suffle with saithe and form fish with cod) more than 50 % of the energy content was provided by fat.

The contents of thiamine, riboflavin, niacin, pantothenic acid, vitamin B₁₂ and biotin are given in Tables 2-4. The thiamine contents in the analysed products ranged from 0.13 to 1.43 mg/kg, giving thiamine densities of 0.09 to 1.49 mg/1000 kcal (Table 2). The values for riboflavine were in the range of 0.03 to 2.19 mg/kg, resulting in riboflavine densities in the products of 0.01 to 2.00 mg/1000 kcal. The contents of niacin varied from 4.89 to 26.67 mg/kg corresponding to 3.4 to 23.3 mg/1000 kcal (Table 3).

For an adult man Statens Ernæringsråd (Norwegian National Nutrition Council) has recommended daily intakes of thiamine, riboflavin and niacin of 1.5, 1.7 and 19 mg, respectively, corresponding to vitamin densities in relation to the daily energy intake of 0.5, 0.6 and 7 mg/1000 kcal. The density of thiamine was below 0.5 mg/1000 kcal in 5 of the 31 products and in the case of riboflavin below 0.6 mg/1000 kcal in 15 of the 31 products. Regarding niacin, 5 of the 31 products were below a vitamin density of 7 mg/1000 kcal. Calculated on a serving size of 200 g, the products would not supply more than 1.7 to 25.7% of the recommended daily allowances (RDA) of thiamine, riboflavin and niacin.

The content of pantothenic acid varied from 1.63 to 5.99 mg/kg wet weight with an average of 2.86 mg/kg. Considerable variations were found for the contents of vitamin B₁₂ (Table 4). The highest level of this vitamin was found in herring fillet (0.076 mg/kg wet weight). The levels of biotin varied from 0.010 mg/kg in fish balls to 0.112 mg/kg in breaded plaice.

The recommendations from Statens Ernæringsråd (1981) do not include RDA-values for pantothenic acid, biotin and vitamin B₁₂. However, the U.S. National Research Council, Food and Nutrition Board, has stated that a daily intake of 10 mg of pantothenic acid is probably adequate for adults. As shown in Table 3 a portion of 200 gram will cover less than 10% of a recommended daily allowance of 10 mg of pantothenic acid in 30 of the 31 products analysed.

The Joint FAO/WHO Expert Group (1970) recommends a daily intake of 0.002 mg vitamin B₁₂ for the normal adult. Thus, assuming a portion size of 200 gram, products containing more than 0.010 mg/kg wet weight should satisfy the recommended daily intake. This requirement was met by 25 of the 31 products analysed. The fish products, and especially products based on saithe, were generally good sources of vitamin B₁₂, supplying 73 to 766 percent of the RDA-value recommended by the Joint FAO/WHO Expert Group (1970). Only fish soup was found to be free of vitamin B₁₂. The RDA-values for biotin are based on a recommended intake of 0.3 mg per day (Appel and Briggs, 1980). A portion size of 200 gram will meet less than 3.0% of a biotin intake of 0.3 mg/day in all products analysed. However, the amount of the vitamin usually ingested, in addition to biotin available from intestinal synthesis, is likely to be well in excess of minimal biotin requirements under normal dietary conditions.

Table 1. The contents of water, protein (N×6.25), fat, carbohydrates, and ash (in g/kg wet weight), energy and energy percentages from protein, fat and carbohydrates in Norwegian frozen fish products.

Product	Water g/kg	Protein g/kg	Fat g/kg	Carbo- hydrates g/kg	Ash g/kg	kcal/kg	PE/TE %	FE/TE %	CE/TE %
Cod, smoked									
<i>Lettrøkt torsk</i>	832.0	141.3	0.1	0.0	26.4	570.9	99.9	0.1	0.0
Cod portions, lightly salted									
<i>Lettsprengt torsk</i>	836.0	142.9	0.1	0.0	27.6	549.1	99.9	0.1	0.0
Haddock, smoked									
<i>Lettrøkt kolje</i>	823.0	143.2	0.1	0.0	33.5	577.5	99.9	0.1	0.0
Cod fillets w/shrimps in dill sauce									
<i>Torskefilet m/reker i dillsaus</i>	858.0	92.3	21.7	18.6	9.4	638.9	57.7	30.5	11.6
Herring fillet, cured/salted									
<i>Spekesild</i>	678.0	164.9	66.2	11.7	79.2	1302.2	50.6	45.7	3.5
Saithe fillet in mussle sauce									
<i>Seifilet m/muslingsaus</i>	798.0	125.8	41.0	24.0	13.2	968.2	51.9	38.1	9.9
Saithe fillet in mustard sauce									
<i>Seifilet m/sennepsaus</i>	776.0	130.3	49.1	32.1	12.5	1091.5	47.7	40.4	11.7
Cod, breaded sticks									
<i>Grilletter av torsk</i>	701.0	148.7	1.0	136.4	12.9	1149.4	51.7	0.7	47.4
Cod, breaded fillet (raw)									
<i>Torskepanetter</i>	698.0	138.9	2.3	145.5	15.3	1158.3	47.9	1.7	50.2
Cod, breaded fillet									
<i>Panert torsk</i>	685.0	136.1	11.6	163.1	14.2	1301.2	41.8	8.0	50.1
Cod burgers, breaded portions									
<i>«Fishburgers»</i>	727.0	133.0	0.1	126.0	13.1	1044.1	50.9	0.0	48.2
Cod, fish fingers (precooked)									
<i>Frityrsteckt torsk</i>	621.0	128.5	73.9	161.4	15.2	1824.7	28.1	36.4	35.3

Cod, fried										
<i>Steketorsk</i>	752.0	123.6	2.4	110.2	11.8	956.8	51.6	2.2	46.0	
Cod, breaded portions										
<i>Rett-i-panne torsk</i>	782.0	151.8	1.4	52.4	12.4	829.4	73.2	1.5	25.2	
Fishcakes, breaded										
<i>Fiskekroetter</i>	733.0	131.1	2.3	121.2	12.4	1029.9	50.9	2.0	47.0	
Plaice, breaded fillet										
<i>Panert rødspette</i>	673.0	136.6	8.0	173.1	9.3	1310.8	41.6	5.4	52.8	
Saithe, breaded fillet										
<i>Panert sei</i>	675.0	154.7	2.6	154.0	13.7	1258.2	49.1	1.8	48.9	
Saithe, breaded portions										
<i>Grilletter av sei</i>	688.0	145.7	2.3	152.3	11.7	1212.7	48.0	1.7	50.2	
Saithe, breaded, w/paprika										
<i>Variantfisk med paprika</i>	689.0	128.4	22.9	139.5	20.2	1277.7	40.1	16.1	43.6	
Saithe, fish fingers (precooked)										
<i>Frityrstekt sei</i>	582.0	152.6	82.8	170.5	12.1	2037.6	29.9	36.5	33.4	
Saithe, fillet w/onion										
<i>Seibiff mløk</i>	786.0	119.6	23.9	57.9	12.6	925.1	51.7	23.2	25.0	
Fish balls. <i>Fiskeboller</i>	862.0	72.9	10.7	42.9	11.5	559.5	52.1	17.2	30.6	
Cod cakes w/leek. <i>Torskekaker m/purre</i>	673.0	104.2	22.9	176.8	23.1	1330.1	31.3	15.4	53.1	
Fish cakes. <i>Fiskekaker</i>	761.0	109.7	49.6	62.6	17.1	1135.6	38.6	39.3	22.0	
Fish cakes. <i>Fiskekarbonader</i>	713.0	115.2	96.4	53.9	21.5	1544.0	29.8	56.1	13.9	
Fish soup. <i>Fisquesuppe</i>	734.0	68.8	91.8	83.5	21.9	1435.4	19.1	57.5	23.2	
Fish soufflé w/cod. <i>Fiskegrateng</i>	742.0	100.9	30.4	114.1	12.6	1133.6	35.6	24.1	40.2	
Fish soufflé w/cod. <i>Gammeldags fiskegrateng</i>	712.0	89.0	64.9	116.9	17.2	1407.7	25.2	41.4	33.2	
Fish soufflé w/saithe. <i>Fin fiskegrateng</i>	676.0	124.9	105.9	75.9	17.3	1756.3	28.4	54.2	17.2	
Form-fish, cod w/lemon. <i>Fisk i form m/sitron</i>	725.0	142.0	80.9	34.7	17.4	1434.9	39.5	50.7	9.6	
Stew w/saithe. <i>Mormors beste seifrikase</i>	836.0	70.2	31.4	48.0	14.4	755.4	37.1	37.4	25.4	

Table 2. The contents of thiamine and riboflavine in Norwegian frozen fish products.

Product	Thiamine			Riboflavine		
	mg/kg	mg/1000 kcal	%RDA ¹	mg/kg	mg/1000 kcal	%RDA ¹
Cod, smoked						
<i>Lettrøkt torsk</i>	0.68	1.18	9.0	0.57	1.00	6.7
Cod portions, lightly salted						
<i>Lettsprengt torsk</i>	0.58	1.05	7.7	0.43	0.79	5.1
Haddock, smoked						
<i>Lettrøkt kolje</i>	0.61	1.05	8.1	0.46	0.79	5.3
Cod fillets w/shrimps in dill sauce						
<i>Torskefilet m/reker i dillsaus</i>	0.43	0.67	5.7	0.28	0.44	3.3
Herring fillet, cured/salted						
<i>Spekesild</i>	0.13	0.09	1.7	1.14	0.87	13.4
Saithe fillet in mussle sauce						
<i>Seifilet m/muslingsaus</i>	1.19	1.22	15.8	1.08	1.12	12.7
Saithe fillet in mustard sauce						
<i>Seifilet m/sennepsaus</i>	0.95	0.86	12.6	2.19	2.00	25.7
Cod, breaded sticks						
<i>Grilletter av torsk</i>	0.81	0.70	10.8	0.28	0.24	3.3
Cod, breaded fillet (raw)						
<i>Torskepanetter</i>	1.10	0.95	14.6	0.35	0.30	4.1
Cod, breaded fillet						
<i>Panert torsk</i>	0.98	0.74	13.0	0.03	0.01	0.3
Cod burgers, breaded portions						
<i>Fishburgers</i>	0.88	0.84	11.7	0.28	0.26	3.2
Cod, fish fingers (precooked)						
<i>Frityrstek torsk</i>	0.93	0.51	12.4	0.17	0.09	1.9

Cod, fried						
<i>Steketorsk</i>	1.43	1.49	19.0	0.63	0.65	7.4
Cod, breaded portions						
<i>Rett-i-panne torsk</i>	0.73	0.88	9.7	0.26	0.31	3.1
Fishcakes, breaded						
<i>Fiskekroetter</i>	0.68	0.65	9.0	0.37	0.36	4.3
Plaice, breaded fillet						
<i>Panert rødspette</i>	1.82	1.39	24.3	0.60	0.45	7.0
Saithe, breaded fillet						
<i>Panert sei</i>	1.39	1.10	18.5	0.88	0.70	10.3
Saithe, breaded portions. <i>Grilletter av sei</i>	0.99	0.81	13.1	0.79	0.65	9.3
Saithe, breaded, w/paprika. <i>Variantfisk med paprika</i> ..	1.32	1.03	17.6	1.52	1.19	17.9
Saithe, fish fingers (precooked). <i>Frityrstekt sei</i>	1.30	0.63	17.3	0.76	0.37	8.9
Saithe, fillet w/onion. <i>Seibiff m/løk</i>	1.08	1.16	14.3	0.71	0.77	8.4
Fish balls. <i>Fiskeboller</i>	0.38	0.68	5.0	0.37	0.65	4.3
Cod cakes w/leek. <i>Torskekaker m/purre</i>	0.98	0.73	13.0	0.53	0.40	6.3
Fish cakes. <i>Fiskekaker</i>	0.48	0.42	6.4	0.44	0.46	6.2
Fish cakes. <i>Fiskekarbonader</i>	0.74	0.48	9.9	0.94	0.61	11.1
Fish soup. <i>Fisquesuppe</i>	0.49	0.33	6.4	0.44	0.30	5.1
Fish sufflé w/cod. <i>Fiskegrateng</i>	0.46	0.40	6.1	0.45	0.39	5.2
Fish sufflé w/cod. <i>Gammeldags fiskegrateng</i>	0.73	0.51	9.7	0.94	0.66	11.0
Fish sufflé w/saithe. <i>Fin fiskegrateng</i>	1.26	0.71	16.8	2.10	1.19	24.6
Form-fish, cod w/lemon. <i>Fisk i form m/sitron</i>	0.77	0.53	10.2	0.31	0.21	3.6
Stew w/saithe. <i>Mormors beste seifrikase</i>	0.78	1.02	10.3	0.85	1.12	9.9

¹ The percentage of the recommended daily allowances based on a serving size of 200 g.

Table 3. The contents of pantothenic acid and niacin in Norwegian frozen fish products. The values are based on wet weight.

Product	mg/kg	Pantothenic acid		mg/kg	Niacin	
		mg/1000 kcal	% RDA ¹		mg/1000 kcal	% RDA ¹
Cod, smoked						
<i>Lettrøkt torsk</i>	1.85	3.23	3.6	11.68	20.45	12.2
Cod portions, lightly salted						
<i>Lettsprengt torsk</i>	2.12	3.85	4.2	8.99	16.36	9.4
Haddock, smoked						
<i>Lettrøkt kolje</i>	2.62	4.53	5.2	22.13	38.31	23.2
Cod fillet w/shrimps in dill sauce						
<i>Torskefilet m/reker i dillsaus</i>	1.86	2.91	3.7	6.86	10.73	7.2
Herring fillet, cured/salted						
<i>Spekesild</i>	5.99	4.59	11.9	23.28	17.87	24.5
Saithe fillet in mussle sauce						
<i>Seifilet m/muslingsaus</i>	3.66	3.77	7.3	14.18	14.64	14.9
Saithe fillet in mustard sauce						
<i>Seifilet m/sennepsaus</i>	2.51	2.29	5.0	13.87	12.70	14.5
Cod, breaded sticks						
<i>Grilletter av torsk</i>	2.88	2.50	5.7	26.67	23.20	28.0
Cod, breaded fillet (raw)						
<i>Torskepanetter</i>	1.74	1.50	3.4	10.30	8.89	10.8
Cod, breaded fillet						
<i>Panert torsk</i>	2.26	1.73	4.5	12.81	9.84	13.4
Cod burgers, breaded portions						
<i>Fishburgers</i>	2.59	2.47	5.1	24.46	23.42	25.7
Cod, fish fingers (precooked)						
<i>Frityrstek torsk</i>	2.37	1.30	4.7	10.46	5.73	11.0

Cod, fried						
<i>Steketorsk</i>	2.35	2.45	4.7	12.99	13.58	13.6
Cod, breaded portions						
<i>Rett-i-panne torsk</i>	1.61	1.93	3.2	12.36	14.90	13.0
Fishcakes, breaded						
<i>Fiskekroetter</i>	2.59	2.51	5.1	10.33	10.03	10.8
Plaice, breaded fillet						
<i>Panert rødspette</i>	4.74	3.61	9.4	8.08	6.16	8.5
Saithe, breaded fillet						
<i>Panert seid</i>	3.61	2.86	7.2	16.83	13.38	17.7
Saithe, breaded portions						
<i>Grilletter av sei</i>	3.96	3.26	7.9	15.26	12.58	16.0
Saithe, breaded, w/paprika						
<i>Variantfisk med paprika</i>	4.63	3.62	9.2	13.93	10.90	14.6
Saithe, fish fingers (precooked). <i>Frityrstekt sei</i>	2.92	1.43	5.8	19.81	9.72	20.8
Saithe, fillet w/onion. <i>Seibiff m/løk</i>	2.76	2.98	5.5	14.53	15.70	15.2
Fish balls. <i>Fiskeboller</i>	1.71	3.05	3.4	9.72	17.36	10.2
Cod cakes w/leek. <i>Torskekaker m/purre</i>	2.48	1.86	4.9	12.72	9.56	13.3
Fish cakes. <i>Fiskekaker</i>	2.63	2.31	5.2	17.26	15.19	18.1
Fish cakes. <i>Fiskekarbonader</i>	1.93	1.24	3.8	15.30	9.90	16.1
Fish soup. <i>Fiskesuppe</i>	2.77	1.92	5.5	4.89	3.40	5.1
Fish soufflé w/cod. <i>Fiskegrateng</i>	3.25	2.86	6.5	7.17	6.32	7.5
Fish soufflé w/cod. <i>Gammeldags fiskegrateng</i>	3.74	2.65	7.4	7.26	5.15	7.6
Fish soufflé w/saithe. <i>Fin fiskegrateng</i>	3.76	2.13	7.5	13.99	7.96	14.7
Form-fish, cod w/lemon. <i>Fisk i form m/sitron</i>	1.63	1.13	3.2	11.47	7.99	12.0
Stew w/saithe. <i>Mormors beste seifrikase</i>	3.28	4.34	6.5	8.25	10.92	8.6

¹ See Table 2.

Table 4. The contents of vitamin B₁₂ and biotin in Norwegian frozen fish-products. The values are based on wet weight.

Product	B ₁₂			Biotin		
	mg/kg	mg/1000 kcal	% RDA ¹	mg/kg	mg/1000 kcal	% RDA ¹
Cod, smoked						
<i>Lettrøkt torsk</i>	0.017	0.03	174.7	0.019	0.03	1.2
Cod portions, lightly salted						
<i>Lettsprengt torsk</i>	0.016	0.03	165.6	0.015	0.02	1.0
Haddock, smoked						
<i>Lettrøkt kolje</i>	0.015	0.02	157.5	0.016	0.02	1.0
Cod fillets w/shrimps in dill sauce						
<i>Torskefilet m/reker i dillsaus</i>	0.010	0.01	102.2	0.013	0.02	0.9
Herring fillet, cured/salted						
<i>Spekesild</i>	0.076	0.05	766.3	0.045	0.03	3.0
Saithe fillet in mussle sauce						
<i>Seifilet m/muslingsaus</i>	0.048	0.05	484.8	0.033	0.03	2.2
Saithe fillet in mustard sauce						
<i>Seifilet m/sennepsaus</i>	0.028	0.02	284.4	0.024	0.02	1.6
Cod, breaded sticks						
<i>Grilletter av torsk</i>	0.012	0.01	128.5	0.014	0.01	0.9
Cod, breaded fillet (raw)						
<i>Torskepanetter</i>	0.011	0.00	114.7	0.017	0.01	1.1
Cod, breaded fillet						
<i>Panert torsk</i>	0.011	0.00	117.0	0.017	0.01	1.1
Cod burgers, breaded portions						
<i>Fishburgers</i>	0.014	0.01	141.9	0.018	0.01	1.2
Cod, fish fingers (precooked)						
<i>Frityrstek torsk</i>	0.011	0.00	113.7	0.015	0.00	1.0
Cod, fried						
<i>Steketorsk</i>	0.026	0.02	260.4	0.027	0.02	1.8

Cod, breaded portions									
<i>Rett-i-panne torsk</i>	0.009	0.01	95.9	0.015	0.01	1.0			
Fishcakes, breaded									
<i>Fiskekroketter</i>	0.013	0.01	136.1	0.016	0.01	1.1			
Plaice, breaded fillet									
<i>Panert rødspette</i>	0.007	0.00	75.2	0.112	0.08	7.4			
Saithe, breaded fillet									
<i>Panert sei</i>	0.039	0.03	390.0	0.024	0.01	1.6			
Saithe, breaded portions									
<i>Grilletter av sei</i>	0.032	0.02	327.6	0.021	0.01	1.4			
Saithe, breaded w/paprika									
<i>Varianfisk med paprika</i>	0.029	0.02	298.5	0.027	0.02	1.8			
Saithe, fish fingers (precooked). <i>Frityrstekt sei</i>	0.030	0.01	309.3	0.022	0.01	1.4			
Saithe, fillet w/onion. <i>Seibiff m/løk</i>	0.030	0.03	306.0	0.022	0.02	1.5			
Fish balls. <i>Fiskeboller</i>	0.007	0.01	73.1	0.010	0.01	0.7			
Cod cakes w/leek. <i>Torskekaker m/ purre</i>	0.010	0.00	107.9	0.017	0.01	1.1			
Fish cakes. <i>Fiskekaker</i>	0.013	0.01	131.4	0.013	0.01	0.9			
Fish cakes. <i>Fiskekarbonader</i>	0.022	0.01	226.7	0.030	0.02	2.0			
Fish soup. <i>Fiskesuppe</i>	0.000	0.00	0.0	0.013	0.00	0.9			
Fish soufflé w/cod. <i>Fiskegrateng</i>	0.008	0.00	87.7	0.017	0.01	1.1			
Fish soufflé w/cod. <i>Gammeldags fiskegrateng</i>	0.008	0.00	83.5	0.029	0.02	1.9			
Fish soufflé w/saithe. <i>Fin fiskegrateng</i>	0.031	0.01	317.5	0.027	0.01	1.8			
Form-fish, cod w/lemon. <i>Fisk i form m/sitron</i>	0.011	0.00	116.0	0.017	0.01	1.1			
Stew w/saithe. <i>Marmors beste seifrikase</i>	0.016	0.02	168.9	0.017	0.02	1.1			

¹ See Table 2.

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