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NUTRIENT CONTENTS IN CANNED FOOD PRODUCTS FOR INFANTS II. MAJOR AND MINOR ELEMENTS

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ABSTRACT

Six canned dinner products to infants aged 3 months, 10 products to infants aged 4–5 months, and 11 products to infants aged 8 months, all available on the Norwegian market, were analysed by atomic absorption spectrophotometry for their contents of the major elements sodium, potassium, magnesium and calcium, and the trace elements iron, copper, zink, manganese, selenium and mercury. Four of the 27 products available were based on fish, and the authors wished to evaluate these products relative to the average composition of the products offered on the market as infant's dinner foods. The results are given in three tables as concentrations based on wet weight, as daily intakes based on the meal sizes recommended by the manufacturers, and for five of the elements as percentages of the recommended daily allowances (RDA values) as given by either the U.S. National Research Council, Food and Nutrition Board, or by the Norwegian National Nutrition Council.

The daily intakes of the five elements magnesium, calcium, iron, copper and zinc for which recommended daily allowances were available, covered with a few exceptions 1–20% of the RDA values in the suggested meal sizes. High levels of copper were found in products based on liver and of zinc in products of meat-balls and cod roe. The manganese contents in the products would give a daily intake of 20–180 microgram, with the highest values in «Vegetables and liver» and «Cod roe and vegetables». The contents of selenium were generally low, 1–20 microg/g, but the mean value of the four products based on fish was nearly 8 times higher than the average with values between 22 and 57 microg/g. The levels of mercury (0.003–0.04 microg/g) were too low to represent a dietary problem for infants. Of the four products based on fish only «cod roe and vegetables» provided more than minor amounts of the analysed elements, except for selenium.

INTRODUCTION

Dietary suveys are commonly used to establish nutritional profiles in population groups with respect to different elements. Such surveys are not sufficient for the assessment of the nutritional status, they may, however, give valuable information as to which individuals or groups could be at risk regarding certain nutrients (GOODHART and SHILLS, 1973). Infants are regarded as a group of risk because they have a larger energy intake per

kilogram body weight than adults. The growing tendency to use industrially produced infant foods has focussed the attention on their nutritional quality. Thus EGGUM (1977) found Danish dinner products for infants to be of low protein quality. OMANG (1978) found Norwegian food products for infants to be low in zinc and copper.

Of 27 products on the Norwegian market at the time the present study was started, only 4 were based on fish*. We wished to evaluate these products relative to the complete range of such products, and therefore an extensive analysis was carried out on contents of vitamins and major and minor elements in different industrially produced infant food products («dinner» combinations). This paper is the second part of the study, aiming at establishing data for the intake of 4 major and 6 minor elements in the products previously analysed for vitamins (LIED and JULSHAMN, 1983), and evaluating the intake of elements compared to accepted recommended daily allowances (RDA values).

MATERIALS AND METHODS

Details regarding sampling and the treatment of the samples before ashing are given in the preceeding paper (LIED and JULSHAMN, 1983).

All elements were analysed by atomic absorption spectrophotometry (AAS), and with the exception of selenium and mercury they were determined in a digest of nitric acid and perchloric acid (JULSHAMN and BRÆKKAN, 1975). Sodium and potassium were measured in the emission mode and the other elements by flame absorption. Details of all procedures and instrumental settings are given by JULSHAMN et al. (1978). Samples for selenium and mercury determinations were digested simultanously in nitric acid and suphuric acid (1:1 v/v) containing 0.1% vanadiumpentoxide (EGAAS and JULSHAMN, 1978). Mercury was determined by the «cold vapour» technique in a gas cuvette whereas a heated quartz cell was used for the selenium measurements (JULSHAMN et al., 1982).

RESULTS AND DISCUSSION

Sodium, *potassium*, *magnesium* and *calcium* contents are summarized in Table 1. The sodium contents ranged from 1.2 to 2.6, averaging 1.9 ± 0.3 g/kg, excluding a product based on bouillon. The values for potassium were within the same range, averaging 1.8 ± 0.5 g/kg. Calculated on a daily meal size of 50 g resp. 100 g the products would supply 60 to 170 mg of these two

* A product of «fish balls» included in the preceeding paper fell out from this study.

elements to infants up to six months of age, and 100 to 270 mg for infants aged 8 months of more. No recommended daily allowance values are available for infants. The RDA values given for adults are 5–20 g of sodium and 5 g of potassium (DAVIDSON et al., 1972).

Magnesium contents varied between 60 and 160 mg/kg with an average of 104 ± 30 mg/kg. The U.S. National Research Council, (NRC), Food and Nutrition Board, (1968) recommended a daily allowance of 60 mg for infants between 2–6 months, and 70 mg for infants aged 6–12 months. The dinner products thus would supply 6–20 percent of these RDA values. The products containing fish were in the upper concentration range. Generally the highest magnesium concentrations are found in cereals and vegetables which contribute approximately two thirds of the daily intake to adults.

The calcium contents were low and varied widely within the range 48 mg/kg in «liver and vegetables» to 460 mg/kg in «meat balls». The latter product also had the highest zinc content. The daily intake from these dinners would cover not more than 0.9–6.4% of the recommended daily allowances of 360 and 540 mg for infants up to 6 months and 6–12 months, respectively (Statens Ernæringsråd, National Nutrition Council of Norway, 1981). Milk normally supplies the infant's basic need for this element.

Iron, *copper* and *zinc* contents are summarized in Table 2. Products for infants up to three months of age had iron contents within 2.5 to 5.6 mg/kg. Products labelled 4–5 months and 8 months varied within wider ranges with values from 1.4 to 16 mg/kg. The highest iron level was found in a product of «Cod roe and vegetables» with 16 mg/kg, whereas other products of fish origin were low in iron. Statens Ernæringsråd (1981) has recommended a dietary iron intake of 5 mg/d and 10 mg/d for infants up to 6 months and 6–12 months, respectively. The analysed dinner products would give iron intakes between 1.5% and 16% of these RDA values. The NRC (1974) recommended RDA values of 10–15 mg, and these values would be met even less. Human milk is reported to contain 0.5 mg/l of iron (FIELDING and SPEYER, 1974), and would not supply the difference. The infant's need for iron is usually covered by iron fortification of porridge flour.

The copper contents were, with the exception of products containing liver, in the range 0.58 to 1.4 mg/kg. Products containing liver varied between 2 and 10 mg copper per kg, corresponding well with results reported by OMANG (1978).

A report from the Ministry of Agriculture, Fisheries and Food, U.K. (1978) gave high copper values in food containing liver and kidney. The fish products analysed all had copper values below 1 mg/kg. Compared to the NRC (1980) recommended daily dietary allowances for infants in different age groups, the products analysed, excepting those containing liver, would supply 5% to 23% of the RDA values. The products containing liver would supply 17% to 170% of the RDA value in a meal portion.

Table 1. Major element concentrations in canned dinner products to infants in different age groups. The values are based on wet weight.

Age group	Sample	Na		K		Mg			Ca		
		g/kg	mg[a]	g/kg	mg[a]	mg/kg	mg[a]	%[b]	mg/kg	mg[a]	%[b]
3 months	Veal and vegetables										
	Kalv med grønnsaker	1.6	80	1.6	77	88	4.4	7.3	87	4.4	1.2
	Chicken in bouillon										
	Kylling i kraft	3.4	168	1.2	60	70	3.5	5.8	244	12	3.3
	Lamb and vegetables										
	Lam og grønnsaker	1.4	72	2.4	103	120	5.7	9.5	74	3.7	1.0
	Mixed vegetables										
	Blandede grønnsaker	2.2	109	3.2	158	150	7.7	12.8	155	7.7	2.1
	Vegetables and lamb										
	Grønnsaker og lam	2.0	100	1.8	90	86	4.3	7.2	92	4.6	1.3
	Vegetables and liver										
	Grønnsaker og lever	1.8	90	1.4	69	69	3.4	5.7	79	4.0	1.1
4–5 months	Veal and vegetables										
	Kalv med grønnsaker	1.4	70	1.9	95	132	6.6	11.0	189	9.5	2.6
	Chicken, rice and vegetables										
	Kylling med ris og grønnsaker	1.6	80	1.5	75	96	4.8	8.0	71	3.6	1.0
	Cod and carrot										
	Torsk med gulrot	2.1	105	2.6	130	137	6.9	11.5	91	6.6	1.3
	Cod roe and vegetables										
	Torskerogn med grønnsaker	*2.2*	*110*	*2.1*	*105*	*124*	*6.2*	*10.3*	*213*	*10.7*	*3.0*
	Fish, tomato and vegetables										
	Fisk med tomater og grønnsaker	1.9	95	2.1	105	114	5.7	9.5	75	3.8	1.1
	Meat balls										
	Kjøttboller	2.6	130	1.3	65	94	4.7	7.8	460	23	6.4
	Mixed vegetables										
	Grønnsakmiddag	1.2	60	1.8	90	121	6.6	11.0	76	3.8	1.1
	Turkey and vegetables										
	Kalkun med grønnsaker	2.3	115	1.4	70	69	3.5	5.8	124	6.2	1.7

Age group	Sample	Na		K		Mg			Ca		
		g/kg	mg[a]	g/kg	mg[a]	mg/kg	mg[a]	%[b]	mg/kg	mg[a]	%[b]
	Vegetables and beef										
	Grønnsaker med oksekjøtt	1.8	90	1.7	90	100	5.0	8.3	98	4.9	1.4
	Vegetables and liver										
	Grønnsaker med lever	1.7	85	1.8	90	163	8.2	13.7	315	15.8	4.4
8 months	Beef and vegetables										
	Oksekjøtt med grønnsaker	1.6	163	1.5	146	92	9.2	13.1	120	11.6	2.1
	Veal and vegetables										
	Kalv med grønnsaker	2.0	198	1.9	185	100	10.1	14.4	89	8.9	1.6
	Chicken and vegetables										
	Kylling med grønnsaker	2.1	205	2.1	206	110	11.0	15.7	85	8.5	1.6
	Cod and vegetables										
	Torsk med grønnsaker	1.9	189	1.9	188	110	10.5	15.0	190	19.4	3.6
	Ham and spagetti										
	Skinke med spaghetti	2.2	216	1.8	178	110	10.7	15.3	79	7.9	1.5
	Lamb and vegetables										
	Lam med grønnsaker	1.9	189	1.8	179	100	10.1	14.4	110	11.4	2.1
	Liver, bacon and vegetables										
	Lever og bacon med grønnsaker	2.3	232	2.5	245	120	13.3	19.0	74	7.4	1.4
	Liver and vegetables										
	Lever med grønnsaker	1.7	172	1.3	126	70	7.0	10.0	48	4.8	0.89
	Roast venison and vegetables										
	Dyrestek med grønnsaker	1.4	140	2.7	269	140	14.2	20.3	145	14.5	2.7
	Summer vegetables and ham										
	Sommergrønnsaker med skinke	1.8	184	1.1	105	58	5.8	8.3	75	7.5	1.4
	Tyrkey, tomato and rice										
	Kalkun med tomatris	2.1	208	1.2	121	59	5.9	8.4	120	11.9	2.2

[a] The values are based on å serving size of 50 g at 3 months and 4–5 months, and 100 g at 8 months, respectively.
[b] Percentage of the NCR recommended daily allowances (for calcium: Statens Ernæringsråd).

Table 2. Minor element concentrations in canned products to infants in different age groups. The values are based on wet weight.

Age group	Sample	Fe			Cu			Zn		
		mg/kg	mg[a]	%[b]	mg/kg	mg[a]	%[b]	mg/kg	mg[a]	%[b]
3 months	Veal and vegetables									
	Kalv og grønnsaker	3.9	0.19	3.9	0.67	0.03	5.0	4.8	0.24	6.0
	Chicken in buillon									
	Kylling i kraft	2.5	0.12	2.4	0.89	0.04	6.7	3.0	0.15	3.8
	Lamb and vegetables									
	Lam og grønnsaker	4.2	0.21	4.2	0.84	0.04	6.7	4.1	0.21	5.3
	Mixed vegetables									
	Blandede grønnsaker	5.6	0.28	5.6	1.4	0.07	11.7	4.0	0.20	5.0
	Vegetables and lamb									
	Grønnsaker og lam	3.1	0.15	3.0	0.71	0.04	6.7	3.8	0.09	4.8
	Vegetables and liver									
	Grønnsaker og lever	4.2	0.36	7.2	2.0	0.10	16.7	3.4	0.17	4.3
4–5 months	Veal and vegetables									
	Kalv og grønnsaker	6.7	0.34	6.8	1.0	0.05	8.3	6.8	0.34	8.5
	Chicken, rice and vegetables									
	Kylling med ris og grønnsaker	4.3	0.21	4.2	0.91	0.05	8.3	3.3	0.17	4.3
	Cod and carrot									
	Torsk med gulrot	1.7	0.08	1.6	0.84	0.04	6.7	2.2	0.11	2.8
	Cod roe and vegetables									
	Torskerogn med grønnsaker	16	0.80	16	0.92	0.05	8.3	9.6	0.48	12.0
	Fish, tomato and vegetables									
	Fisk med tomat og grønnsaker	1.4	0.07	1.4	0.59	0.03	5.0	1.8	0.09	2.3
	Meat balls									
	Kjøttboller	11	0.55	11	1.2	0.06	10	22	1.11	27.8
	Mixed vegetables									
	Grønnsakmiddag	5.1	0.25	5.0	1.0	0.05	8.3	2.7	0.13	3.3
	Turkey and vegetables									
	Kalkun méd grønnsaker	4.2	0.21	4.2	0.85	0.04	6.8	5.0	0.25	6.3

Age group	Sample	Fe			Cu			Zn		
		mg/kg	mg[a]	%[b]	mg/kg	mg[a]	%[b]	mg/kg	mg[a]	%[b]
	Vegetables and beef									
	Grønnsaker med oksekjøtt	8.0	0.40	8.0	1.0	0.05	8.3	6.8	0.34	8.5
	Vegetables and liver									
	Grønnsaker med lever	11	0.56	11.2	4.0	0.20	33.3	6.5	0.32	8.0
8 months	Beef and vegetables									
	Oksekjøtt med grønnsaker	5.0	0.50	5.0	0.84	0.08	14.0	8.9	0.89	22.3
	Veal and vegetables									
	Kalv med grønnsaker	5.3	0.53	5.3	0.90	0.09	15.0	6.8	0.68	17.0
	Chicken and vegetables									
	Kylling med grønnsaker	5.6	0.56	5.6	1.4	0.14	23.3	3.8	0.38	9.5
	Cod and vegetables									
	Torsk med grønnsaker	2.6	0.26	2.6	0.71	0.07	11.8	2.9	0.29	7.3
	Ham and spaghetti									
	Skinke og spaghetti	9.2	0.92	9.2	1.3	0.13	21.7	6.7	0.67	16.8
	Lamb and vegetables									
	Lam med grønnsaker	5.3	0.53	5.3	0.90	0.09	15.0	6.1	0.61	15.3
	Liver, bacon og grønnsaker									
	Lever bacon og grønnsaker	13	1.3	13	3.2	0.32	53.3	6.8	0.68	17.0
	Liver and vegetables									
	Lever med grønnsaker	11	1.1	10.6	10.2	1.02	170	6.4	0.64	16.0
	Roast venison and vegetables									
	Dyrstek med grønnsaker	8.3	0.83	8.3	1.1	0.11	18.3	8.5	0.85	21.3
	Summer vegetables and ham									
	Sommergrønnsaker med skinke	3.3	0.33	3.3	0.74	0.07	12.3	3.1	0.31	7.8
	Turkey, tomato and rice									
	Kalkun med tomatris	2.8	0.28	2.8	0.58	0.06	9.7	4.0	0.40	10.0

[a] The values are based on å serving size of 50 g at 3 months and 4–5 months, and 100 g at 8 months, respectively.
[b] Percentage of the NCR recommended daily allowances (for iron: Statens Ernæringsråd).

Table 3. Minor element concentrations in canned dinner products to infants in different age groups. The values are based on wet weight.

Age group	Sample	Mn		Se		Hg	
		mg/kg	mg[a)]	mg/kg	mg[a)]	mg/kg	mg[a)]
3 months	Veal and vegetables *Kalv og grønnsaker*	1.2	0.06	0.001	0.0001	0.015	0.0008
	Chicken in bouillon *Kylling i kraft*	0.42	0.02	0.002	0.0001	0.017	0.0009
	Lamb and vegetables *Lam og grønnsaker*	1.6	0.08	0.002	0.0001	0.004	0.0002
	Mixed vegetables *Blandede grønnsaker*	1.8	0.09	0.002	0.0001	0.027	0.0014
	Vegetables and lamb *Grønnsaker og lam*	0.91	0.05	0.001	0.0005	0.003	0.0002
	Vegetables and liver *Grønnsaker og lever*	0.94	0.05	0.009	0.0005	0.003	0.0002
4–5 months	Veal and vegetables *Kalv og grønnsaker*	1.6	0.08	0.002	0.0001	0.020	0.0010
	Chicken, rice and vegetables *Kylling med ris og grønnsaker*	1.7	0.09	0.008	0.0004	0.028	0.0014
	Cod and carrot *Torsk med gulrot*	0.48	0.02	0.057	0.0029	0.034	0.0017
	Cod roe and vegetables *Torskerogn med grønnsaker*	2.0	0.10	0.053	0.0026	0.010	0.0005
	Fish, tomato and vegetables *Fisk med tomat og grønnsaker*	0.26	0.01	0.055	0.0028	0.023	0.0012
	Meat balls *Kjøttboller*	0.56	0.03	0.020	0.0010	0.039	0.0020
	Mixed vegetables *Blandede grønnsaker*	1.4	0.07	0.005	0.0003	0.023	0.0012
	Turkey with vegetables *Kalkun med grønnsaker*	1.3	0.06	0.007	0.0004	0.029	0.0015

Age group	Sample	Mn		Se		Hg	
		mg/kg	mg[a)]	mg/kg	mg[a)]	mg/kg	mg[a)]
	Vegetables and beef						
	Grønnsaker med oksekjøtt	1.4	0.07	0.008	0.0004	0.014	0.0007
	Vegetables and liver						
	Grønnsaker med lever	3.5	0.18	0.002	0.0001	0.011	0.0006
8 months	Beef and vegetables						
	Oksekjøtt med grønnsaker	1.5	0.15	0.005	0.0005	0.004	0.0004
	Veal and vegetables						
	Kalv med grønnsaker	0.92	0.09	0.007	0.0007	0.006	0.0006
	Chicken and vegetables						
	Kylling med grønnsaker	0.81	0.08	0.002	0.0002	0.005	0.0005
	Cod and vegetables						
	Torsk med grønnsaker	1.2	0.12	0.022	0.0022	0.013	0.0013
	Ham and spaghetti						
	Skinke med spaghetti	0.92	0.09	0.015	0.0015	0.006	0.0006
	Lamb and vegetables						
	Lam med grønnsaker	1.2	0.12	0.003	0.0003	0.008	0.0008
	Liver, bacon and vegetables						
	Lever og bacon med grønnsaker	1.6	0.16	0.002	0.0002	0.006	0.0006
	Liver and vegetables						
	Lever med grønnsaker	1.0	0.10	0.002	0.0002	0.005	0.0005
	Roast venison and vegetables						
	Dyrestek med grønnsaker	1.3	0.13	0.016	0.0016	0.005	0.0005
	Summer vegetables and ham						
	Sommergrønnsaker med skinke	0.72	0.07	0.006	0.0006	0.003	0.0003
	Turkey, tomato and rice						
	Kalkun med tomatris	0.65	0.07	0.013	0.0013	0.004	0.0004

[a)] The values are based on a serving size of 50 g at 3 months and 4–5 months, and 100 g at 8 months, respectively.

The average zinc content in the «3 months» products was 3.9 ± 0.6 mg/kg corresponding to an average intake of 0.19 mg for meal size of 50 g. The 4–5 months and 8 months groups varied more with ranges of 1.8 to 22 mg/kg and 2.9 to 8.9 mg/kg, respectively. The highest zinc contents were found in meat balls (22 mg/kg) followed by fish roe (9.6 mg/kg), whereas other products of fish origin had low zinc contents. OMANG (1978) estimated the total average intake of a 12 month's old Norwegian infant to 2.5 mg per day, of which the dinner meal supplied 0.59 mg. Our estimates correspond well with this value. The daily intakes of zinc from meals of these products give 2–28% of the 3–5 mg recommended by NRC (1974). Estimating the daily intake of zinc one should consider that the availability is greatly influenced both by the choice and the processing of foods.

Manganese, selenium and *mercury* contents are summarized in Table 3. The manganese contents were within the range 0.3 to 3.5 mg/kg, corresponding to a daily intake of 20 to 180 microgram. The products «Vegetables and liver» and «Cod roe and vegetables» had the highest values. Other products of fish origin gave values in the lower concentration range. MCLEOD and ROBINSON (1972) estimated the intake by infants of 3–6 months in New Zealand to 0.2 mg manganese in the diet without milk addition, and 0.4 mg when cow's milk was given. They suggested that cereal foods and vegetable instant foods may be rich sources of manganese. No RDA values are available.

The four products based on fish had selenium contents between 22 and 57 microg/kg, whereas all other products analysed gave values below 20 microg/kg. The mean content of selenium in the four products based on fish was 8 times higher than the mean of the other 23 products.

A dinner meal of the products would give an intake of 0.1–2.9 microg selenium and this large variation reflects the types of food as well as processing and cooking. Seafoods, liver and meat normally contain more than 0.2 mg/kg, whereas vegetables mostly are poor selenium sources with 0.01 mg/kg or less, and the low values found in the analysed products probably reflect the high content of vegetables in these products.

In the last decades attention has been focussed on the mercury content of food, and in particular organic mercury compounds are regarded as hazardous contaminants. The present analyses show total mercury contents, (inorganic and organic), which for the three groups were: up to 3 months, 0.012 ± 0.009, 4–5 months 0.023 ± 0.13 and 8 months 0.006 ± 0.002 mg Hg/kg. Those based on fish had the highest contents, as was expected. None of the products, however, represent an intake of mercury of dietary significance.

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