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CONSUMPTION PATTERN AND CONTRIBUTION OF ZINC AND ANTIOXIDANT VITAMINS A AND C RICH FOODS TO THE MEAN DAILY NUTRIENT INTAKE OF 2 – 5 YEAR OLD CHILDREN IN TWO RURAL TOWNS IN NIGERIA.

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ABSTRACT

This study was carried out to assess the consumption pattern and contribution of zinc and antioxidant vitamins A and C-rich foods to the mean daily nutrient intake of 2 – 5 year old children, in two rural towns in Anambra state, Nigeria. Questionnaire and 3 – day weighed food intake methods were used. Questionnaires were administered to 192 mothers/caregivers of the 192 randomly selected children. A sub-sample of 20 children were randomly selected for the 3 – day weighed food intake study. All the respondents were Christians by religion and major occupations of the heads of households were trading and/or farming. Majority of the households (53.3%) were of low income group. Their fruit consumption pattern ranged from 30% (velvet tamarind) to 74% (mangoes) on any given day especially when in season. Also 65.1%, 70.8%, 13% of the children took dark green vegetables, dried fish, and breast milk, on any given day, respectively. Rice contributed highest to their daily energy, carbohydrate and niacin intake while beans contributed highest to their protein, calcium, iron and thiamin daily intake. Fruits and vegetables contributed 0.95% to 23% and 14% to 22% of the total mean daily ascorbic acid intake of the 2 – 3 year old and 4 – 5 year old children, respectively. Generally, the children had poor consumption of animal foods whose nutrients like zinc are more bioavailable. Improved agricultural production for more income to the farmers, dietary diversification and fortification together with intensified nutrition education will help to improve nutrient intake of the 2 – 5 year old children in the study area.

Key Words: Ascorbic acid, Antioxidant vitamins, Free radicals, consumption

INTRODUCTION:

Zinc, as well as antioxidant vitamins are all part of essential micronutrients which occupy a very important position in human nutrition.

Zinc is necessary for normal growth and development. Zinc is involved in many biochemical pathways. It participates in synthesis and degradation of carbohydrates, lipids, proteins and nucleic acids. Zinc also helps in liberation of vitamin A from the storage organ, the liver and disposal of free radicals.

The destructive effects of free radicals that are produced during normal biochemical redox reaction need a counter-reaction to protect the body system against the harmful resultant effects. This counter reaction is termed antioxidation while substances involved in this antioxidation are called antioxidants. In other words, antioxidant system defends tissues against free radical attack. The major antioxidant vitamins are vitamins A, C and E. (Anderson, 1995).

Literally, every man is what he/she eats. The shift from frequent consumption of fresh foods to more refined and/ or packaged foods must have contributed to a lot of health problems being encountered today especially in developing countries. Many deficiency problems in Nigeria can be traced down to inadequate dietary intake. Zinc deficiency resulting from inadequate dietary zinc intake has been reported among Nigerian infants, children, pregnant and lactating women (Mbofung and Atinmo, 1987). Antioxidant vitamin deficiencies especially vitamins A and C are nearly always due to poverty in the midst of abundance. Fruits and vegetables sources of the vitamins abound but are not being. rightly given to children due primarily to lack of knowledge of their importance in nutrition and health at large.

The major sources of vitamin C are fruits and vegetables especially spinach, tomatoes, onions, oranges and other citrus fruits. Meat and dairy products contain little vitamin C and none is found in unfortified cereals (Garrow *et al.*, 1998). Already formed vitamin A (retinol) can be found in foods of animal origin such as milk, cheese, butter, egg yolk, some fatty fish, liver of farm animals and fish. Liver oils (cod, halibut, shark) are also rich natural sources of vitamin A. Provitamin A (carotene) are found in dark green leafy vegetables, carrots, paw-paw and mango. The beta-carotene of crude palm oil is a rich source of provitamin A and all carotenes present in red palm oil have antioxidant potential (Packer, 1994). Dietary sources of zinc are protein–rich foods, which include liver, red meat, shellfish and fish. Plant sources include cereals, legumes and tubers.

In Nigeria, much has not been documented on consumption pattern of zinc and antioxidant vitamins–rich foods in children. This study is aimed at assessing consumption pattern and contribution of zinc and antioxidant vitamins (A and C) -rich foods to the mean daily energy/nutrient intake of 2-5 year old children in two rural towns in Anambra State, Nigeria.

MATERIALS AND METHODS

A total of 192 preschool children were randomly selected from two communities, Ezinifite and Uga, in Aguata L.G.A of Anambra State for the study. Questionnaire and 3-day weighed food intake methods were used for data collection. Pretested and validated questionnaires were distributed to mothers/caregivers of the selected children. The questionnaires contained questions on general characteristics of the subjects and 24 – hour dietary recall to elicit information on consumption pattern of zinc and antioxidant vitamins A and C – rich foods of 2 – 5 year old children. A sub-sample of 20 preschool children were randomly selected for 3-day weighed food intake study.

Method

All raw ingredients used in preparing foods for each child were weighed and their individual weights recorded. The empty pot to be used for the food preparation was also weighed and recorded. The total cooked weight of food after cooking was taken. The child's food portion was weighed and plate waste after consumption was noted. Then the actual weight of each ingredient the child consumed from each meal was calculated. This was used to get total weight of each ingredient consumed for the day which was used for nutrient analysis.

Data analysis

Data from the questionnaires were coded on computer sheets and analyzed using Statistical Package for the Social Sciences (SPSS). The analysis that was done included frequency distributions and percentages of respondents.

The nutrient composition of the ingredients consumed by the children were obtained using food composition tables (Platt, 1975; FAO 1968). Meals and snacks taken outside homes were estimated using household measures or selling weights.

Their nutrient content were also obtained. The results of the weighed food intake

calculations were presented as percentages of the daily nutrient intake from zinc and antioxidant vitamins A and C- rich foods consumed.

RESULT

Analysis of the ethnic group of the respondents showed that 100% of the respondents were Igbos. All (100%) respondents were christians by religion. The major occupations of heads of households in Aguata L.G.A were trading and/or farming (Table 1). Examining the monthly household income, 57.3%, 15.6%, 27.1% of the households were classified as low, medium and high-income earners, respectively (as shown in Table 1). Weekly household expenditure on food showed that the least percentage of households (7.8%) spent above ₦10, 000.00 and highest percentage (37%) spent between ₦500.00 and ₦1000.00 (Table1). Table 2 showed that 41.6% of the household had their foods partly home produced and partly purchased. Households that got their foods mostly from home and mostly from market were 31.3% and 27.1% of the households, respectively. The 15.1%, 81.5% and 2.6% of the households used palm oil in bleached, natural and combination of the forms respectively. The greatest percentage (44.8%) of the households gave rice with popular 'banga' soup as their favorite food (Table 2).

Table 3a showed that 76.6%, 50.5%, 58.3%, 33.3% of the subjects in the households took rice, yam, breadfruit, soybean, in any given day, respectively. It showed also that 65.1% took dark – green vegetables on any given day. Table 3b also revealed that their fruit consumption pattern ranged from 3.6% (velvet tamarind) to 74% (mangoes) on any given day when in season. For fish and meat, 70.8% and 65.6% of the households consumed dried fish and crayfish, respectively on any given day. Also, 13% of the children were still being breastfed. In 2-3 year old children, fresh tomatoes supplied 2.89 kcal of energy, 0.08g protein, 2.17mg ascorbic acid while palm oil gave about 380.5 μgRE of vitamin A daily. Fish and meat supplied 0.04mg and 0.38mg of iron daily, respectively. Food from cereal group, rice, contributed highest to their daily energy (183.85 kcal), carbohydrate (41.38g) and niacin (1.08mg) intake (Table 4).

In 4-5 year old children, beans contributed highest to their protein (5.59g), calcium (31.56mg), iron (2.08mg) and thiamin (0.18mg) intake daily. Rice supplied 168.73 kcal of energy. Fresh tomatoes and mangoes contributed 3.61mg and 6.27mg ascorbic acid intake daily, respectively. Fish and meat contributed 1.22g and 1.61g portions of their protein intake, respectively (Table 5).

Fruits and vegetables gave between 0.15% (fresh pepper) and 1.44% (avocado pear) of the total daily energy intake of 2-5 year old children. In 2-3 and 4 -5 year old children, rice contributed 24.78% and 18.77% of their respective daily energy intake (Table 6a). Onions contributed 0.95% and 1.37% of daily ascorbic acid intake in 2-3 year and 4 – 5 year children, respectively (Table 6b). Yams supplied 11.99%, 8.52%, 14.8% and 18.1% of total daily mean energy, protein, carbohydrate and thiamin intake in 2-3 years old children, respectively (Tables 6a/6b). In 4 – 5 year old children, yams contributed 14.23%, 11.0%, 17.23% and 21.88% of total daily mean energy, protein, carbohydrate and thiamin intake, respectively. Palm oil gave highest contribution of daily vitamin A intake of 57.11% and 54.56% of total daily vitamin A intake in 2-3 year old and 4 –5 year old children, respectively (Table 6b).

Table 1: Occupation of heads of households, monthly household income and weekly expenditure on food.

Occupation	Frequency	Percentage
Farmer	56	29.2
Civil servant	15	7.8
Trader	96	50.0
Skilled worker	20	10.4
Unskilled worker	3	1.6
Retired civil servant	2	1.0
Total	192	100
Monthly income (₦)		
Low (12,364 and below)	110	57.3
Medium (13,586 – 29,407)	30	15.6
High (30,648 and above)	52	27.1
Total	192	100
Weeklyexpenditure (₦)		
Less than 500.00	51	26.5
500 – 1,000.00	71	37.0
1,001 – 5000.00	38	19.8
5,001 – 10,000.00	17	8.9
Above 10,000.00	15	7.8
Total	192	100

Table 2: Household food source, Palm-oil usage of the households and favorite foods of the households

Source of food	Frequency	Percentage
Mostly home produced	60	31.3
Partly home produced and partly purchased	80	41.6
Mostly purchased	52	27.1
Total	192	100
Palm oil Usage Form	Frequency	Percentage
Bleached	29	15.1
Normal form	157	81.8
Bleached + Normal	5	2.6
No Indication	1	0.5
Total	192	100
Favourite Foods	Frequency	Percentage
No indication	34	17.7
Rice + Banga soup	86	44.8
Jollof rice	8	4.2
Breadfruit	28	14.6
Cassava foo-foo + soup	21	10.9
Indomine and/or spaghetti	4	2.1
Fruits	1	0.5
Beans + plantain	1	0.5
Beans porridge	6	3.1
Boasted; yam	3	1.6
Total	192	100

Table 3a: Twenty four (24) – Hour Dietary Recall of the 2 – 5 year old children in the Households (Cereals, roots/tuber, legumes and vegetables).

Food groups	Food items	Frequency	Percentage
CEREALS	Rice (Oryza sativa)	147	76.6
	Bread	85	44.3
	Maize (Zea mays)	26	13.5
	Pap (Zea mays)	65	33.9
ROOTS/TUBER			
	Yam (Discorea spp)	97	50.5
	Sweet potatoes (Ipomea batatas)	43	22.4
	Plantain (Musa sapientum)	39	20.3
	Garri (Manihot esculenta)	55	28.6
	Cocoyam (Colocasia esculenta)	45	23.4
	Cassava-fufu (Manihot esculenta)	86	44.8
LEGUMES			
	Soybean (Glycine max)	64	33.3
	Cowpea (Vigna Spp)	40	20.8
	Groundnut (Arachis hypogaea)	57	29.7
	Breadfruit (Treaulia afrcana)	112	58.3
	African yam bean (Sphenostylis stenocarpa)	14	7.3
VEGETABLES			
	Okro (Hibiscus esculentus)	63	32.8
	Dark-green vegetable	125	65.1
	Tomatoes (Lycopersicum esculentum)	91	47.4
	Pepper (Capsicum annum)	118	61.5
	Carrot (Daucus carota)	42	21.9

Table 3b: Twenty four (24) – Hour Dietary Recall of the 2 – 5 year old children in the Households (Fruits, fish/meat and beverages).

Food groups	Food items	Frequency	Percentage
FRUITS			
	Mangoes (Mangifera indica)	142	74.0
	Oranges (Citrus sinensis)	79	41.1
	Paw-paw (Carica papaya)	42	21.9
	Sour sop (Annona muricata)	12	6.3
	Pineapple (Ananas comosusi)	45	23.4
	Avocado pear (Persea americana)	71	37
	Coconut (Cocos nucifera)	50	26
	Cashew (Anacardiam occidentalis)	24	12.5
	Guava (Pisdium guajava)	27	14.1
	Velvet tamarind (Dialium guinense)	7	3.6
	Local apple	15	7.8
	Banana (Musa sapientum)	35	18.2
FISH/MEAT			
	Dried fish	136	70.8
	Frozen fish	63	32.8
	Chicken (Gallus gallus)	45	23.4
	Egg	58	30.2
	Goat meat (Capra eagagrus)	38	19.8
	Beef (Bos spp.)	47	24.5
	Liver	16	8.3
	Stock fish	39	20.3
	Cray fish (Astacus spp.)	126	65.6
	Snail (Achatina margi)	23	12.0
	Turkey meat (Meleagris galloparo)	42	21.9
BEVERAGES			
	Cow's milk	95	49.5
	Palm wine	26	13.5
	Breast milk	25	13
	Beer	5	2.6
	Tea	111	57.8
	Cocoa drinks	38	19.8

Table 4: Mean daily contribution of zinc, and antioxidant vitamins (A and C) rich foods and total daily mean nutrient intake of 2 – 3 years children

Food/Nutrients	Energy (Kcal)	Protein (g)	Fat (g)	Carboh ydrate (g)	Calcium (mg)	Iron (mg)	Vitamin A (µg)	Thiamin (mg)	Riboflav in (mg)	Niacin (mg)	Ascorbi c Acid
Total Daily Mean Intake	741.95± 173.3	14.14± 3.80	13.57± 3.30	140.75± 38.92	216.05± 89.82	7.37± 1.57	666.26± 122.8	0.47± 0.08	0.27± 0.09	4.14± 0.73	22.26± 12.40
Fresh Tomatoes*	2.89	0.08	0.03	0.58	1.19	0.07	24.21	0.01	0.01	0.07	2.17
Fresh Pepper*	1.11	0.03	0.03	0.18	0.67	0.04	45.81	0.01	0.002	0.03	1.17
Onions*	1.19	0.02	0.01	0.27	0.74	0.02	-	0.001	0.001	0.01	0.21
Bitter Leaves*	6.08	0.38	0.04	0.94	14.94	0.52	309.13	-	0.03	0.15	3.68
Ugu (Telferia) *	4.67	0.40	0.03	0.56	58.50	0.12	276.76	-	0.01	0.05	5.21
Avocado Pear*	10.68	0.16	0.70	0.94	3.05	0.22	47.04	0.01	0.02	0.32	2.02
Palm Oil*	30.34	-	3.49	-	-	-	380.5	-	-	-	-
Yam*	88.96	1.20	0.17	20.83	8.68	1.04	17.36	0.09	0.02	0.34	6.07
Beans*	127.02	5.71	0.53	22.98	37.80	2.85	0.15	0.28	0.07	1.03	0.36
Rice*	183.85	2.98	0.81	41.38	5.38	1.08	-	0.13	0.03	1.08	-
Fish*	14.84	1.98	0.43	-	1.36	0.40	-	0.01	0.01	0.28	-
Meat*	6.68	1.19	0.12	-	4.87	0.38	-	0.01	0.02	0.25	-

*Zinc, Vitamins A and C rich foods.

Table 5: Mean Daily Contribution of Zinc, and Antioxidant Vitamins (A and C) Rich Foods and Total Daily Mean Nutrient Intake of 4 – 5 years Children

Food/ Nutrients	Energy (Kcal)	Protein (g)	Fat (g)	Carbohydrate (g)	Calcium (mg)	Iron (mg)	Vitamin A (µg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Ascorbic Acid
Total Daily Mean Intake	898.94 177.78	15.95± 4.27	15.85± 3.98	173.16± 35.49	190.96± 50.80	8.84± 1.96	817.94± 304.07	0.56± 0.12	0.32± 0.07	6.15± 4.64	29.17± 11.84
Fresh Tomatoes*	4.85	0.14	0.04	0.95	1.98	0.12	44.43	0.01	0.010	0.12	3.61
Fresh Pepper*	1.53	0.04	0.03	0.27	0.82	0.04	55.94	0.01	0.01	0.04	1.2
Onions*	2.97	0.04	0.09	0.50	1.41	0.04	-	0.01	0.01	0.01	0.4
Bitter Leaves*	6.92	0.41	0.05	1.09	15.85	0.55	327.97	-	0.04	0.17	3.92
Ugu (Telferia)*	1.98	0.13	0.03	0.28	22.43	0.06	92.73	-	0.01	0.01	1.51
Avocado Pear*	22.56	0.17	5.09	2.75	8.56	0.63	132.45	0.02	0.07	0.90	5.68
Mango*	13.93	0.08	0.04	3.37	5.12	0.26	189.78	0.01	0.01	0.09	6.27
Pawpaw*	7.68	0.12	-	1.8	4.0	0.1	200	0.01	0.04	0.10	4.2
Palm Oil*	34.70	-	3.99	-	-	-	538.58	-	-	-	-
Yam*	131.51	1.75	0.25	29.83	12.43	1.49	24.86	0.12	0.04	0.50	8.70
Beans*	117.94	5.59	0.50	21.26	31.56	2.08	2.63	0.18	0.06	1.00	0.21
Rice*	168.73	2.77	0.74	37.87	5.63	1.13	-	0.12	0.03	1.13	-
Fish*	8.27	1.22	0.17	-	0.83	0.24	-	0.01	0.01	0.17	-
Meat*	12.41	1.61	0.39	-	3.54	0.51	-	0.01	0.02	0.34	-

*Zinc, Vitamins A and C rich foods.

Table 6a: Percentage Contribution of Zinc antioxidant Vitamins (A and C) rich foods to the overall daily mean energy/nutrient intake of 2-5 year old children.

Food/Nutrients	Energy (%)		Protein (%)		Fat (%)		CHO(%)		Ca (%)		Iron (%	
Age Group	A	b	a	b	a	B	A	b	a	B	a	B
Fresh Tomatoes*	0.39	0.54	0.57	0.88	0.19	0.26	0.41	0.55	0.55	1.04	0.97	1.36
Fresh Pepper*	0.15	0.17	0.22	0.27	0.19	0.19	0.13	0.15	0.31	0.42	0.48	0.45
Onions*	0.16	0.33	0.15	0.27	0.04	0.58	0.19	0.29	0.34	0.74	0.28	0.45
Bitter Leaves*	0.82	0.77	2.70	2.57	0.30	0.29	0.67	0.63	6.94	8.31	6.95	6.22
Ugu (Telferia)*	0.63	0.22	2.85	0.81	0.22	0.16	0.39	0.16	27.08	11.99	1.59	0.68
Avocado Pear*	1.44	2.51	1.10	1.08	5.26	12.59	0.67	0.62	1.41	1.76	8.04	7.13
Mango*	-	1.55	-	0.56	-	0.26	-	1.95	-	2.68	-	2.94
Pawpaw*	-	0.83	-	0.53	-	-	-	0.04	-	2.1	-	1.13
Palm Oil*	4.09	3.86	-	-	25.71	25.04	-	-	-	-	-	-
0Yam*	11.99	14.23	8.52	11.0	1.28	1.58	14.80	17.23	4.02	6.38	14.13	16.85
Beans*	17.12	13.12	40.37	35.04	3.87	3.15	16.05	12.29	17.49	16.52	38.61	23.53
Rice*	24.78	18.77	21.06	17.34	5.94	4.67	29.38	21.88	2.44	2.95	14.30	12.78
Fish*	2.00	0.92	13.97	7.64	3.19	1.10	-	-	0.63	0.42	5.03	2.71
Meat*	0.90	1.38	8.45	10.10	0.86	2.43	-	-	2.20	1.85	5.09	5.77

NB: a: 2 – 3 years
b: 4 – 5 years

Table 6b: Percentage Contribution of Zinc antioxidant Vitamins (A and C) rich foods to the overall daily mean energy nutrient intake of 2-5 year old children.

Food/Nutrients	Vitamin A (%)		Thiamin (%)		Riboflavin (%)		Niacin (%)		Ascorbic acid (%)	
Age Group	a	b	a	B	A	B	a	B	a	B
Fresh Tomatoes*	3.63	5.35	1.09	1.82	1.89	3.19	1.72	1.91	9.74	12.39
Fresh Pepper*	6.87	6.84	1.09	0.91	0.75	1.60	0.62	0.58	5.26	4.02
Onions*	-	-	0.11	1.82	0.38	1.60	0.24	0.17	0.95	1.37
Bitter Leaves*	46.39	40.1	-	-	11.1	11.17	3.72	2.81	16.20	13.41
Ugu (Telferia)*	41.31	11.34	-	-	3.78	1.60	1.11	0.25	23.41	5.09
Avocado Pear*	7.06	6.35	1.70	1.43	8.88	8.12	7.74	5.76	9.06	7.64
Mango*	-	23.2	-	1.07	-	3.12	-	1.40	-	21.50
Pawpaw*	-	24.45	-	0.07	-	12.50	-	1.63	-	14.40
Palm Oil*	57.11	54.56	-	-	-	-	-	-	-	-
Yam*	2.61	3.04	18.10	21.88	7.40	11.12	8.20	8.11	27.29	29.84
Beans*	0.02	0.31	54.67	32.79	24.58	19.13	2.40	16.32	1.17	0.71
Rice*	-	-	28.05	21.88	9.44	9.59	25.99	18.31	-	-
Fish*	-	-	1.09	0.91	3.78	1.60	6.78	2.74	-	-
Meat*	-	-	1.09	0.91	5.66	6.38	6.02	5.66	-	-

NB: a: 2 – 3 years
b: 4 – 5 years
*Zinc, Vitamins A and C rich foods

DISCUSSION

Important dietary source of antioxidant nutrients is the intake of fruits and vegetables. It is now well established that persons consuming generous amounts of these foods have a lower risk of chronic disease than do those whose intake is small (Van Poppel et al., 1994, Hennekens, 1986; Colditz 1985). In this study, consumption of fruits and vegetables, which are rich sources of antioxidant vitamins A and C was really high. This may be due to availability of these fruits and vegetables especially when they were in season. The fact that most of the heads of households were farmers and/or traders ensured adequate production and hence availability of these fruits and vegetables at homes and at a very cheap rate in local markets. This also explains why most of the households got their foods either partly from home and partly from market or mostly from home.

The high intake of antioxidant vitamins A and C rich foods was supported by the result obtained through 3-day weighed food intake study which revealed that fruits and vegetables contributed 0.95% to 23% and 1.4% to 22% of the total mean daily ascorbic acid intake of the children in 2-3 year old and 4-5 year old children, respectively. The fruits were not added in the meals but many exposed these fruits and vegetables to some extent for sun drying before consumption. Many complained that fresh fruits and vegetable when consumed without subjecting them to some degree of sun drying gave them stomach discomfort and/or diarrhoea. Sun drying causes considerable destruction of the antioxidant vitamins A and C. Ascorbic acid in particular is water soluble and can easily be lost through wrong–handling, storage, cooking and overall food preparation. Probably due to lack of knowledge of the nature of this antioxidant vitamin, many of the inhabitants of Aguata L.G.A. of Anambra State, as observed through this study, cut their vegetables before washing. In washing, many tend to squeeze the cut vegetables several times in washing water rather than gentle handling. Over-cooking and several reheating of vegetables in prepared meals were also observed and all these result to loss of ascorbic acid.

Palm oil contributed highest to their vitamin A intake. Up to 80.7% of the children took palm oil on any given day and 81.8% took it in its natural form. Also most of the households (44.8%) indicated rice with banga soup, which is a soup that is based on palm fruit pulp extract, as their favorite food. According to Manorama and Rukmin (1992), the β-carotene of crude palm oil is a rich source of pro–vitamin A and all the carotenes present in red palm oil have antioxidant potential (Packer, 1994). This means that the gap in bioavailability of vitamin A created through sundrying of fruits and vegetables may be filled by adequate utilization of palm oil.

Generally, the children had higher intake of plant foods than animal foods. With exception of fish (dried fish and crayfish) and meat, all other foods recorded were of plant origin. This must be due to cost and availability. Animal foods are normally more costly when compared with plant foods. Sea foods and meat are known to be rich sources of zinc. Zinc from plant foods like cereals, legumes, roots/tubers are poorly bioavailable due to presence of factors like fibre and myoinositol hexaphosphate (phytate) in the staples. Bioavailability of zinc in plant foods can be improved by employing processes like fermentation, germination and soaking. In the study, fish and meat contributed less than 7% each of their energy, fat, minerals and vitamins intake with exception of protein where meat contributed 8.45% and 10.10% in 2-3 year old and 4 –5 year old children, respectively. This shows poor consumption of animal foods whose nutrients like zinc are more bioavailable than from plant foods.

Again, it is worth noting that 13% of mothers still breastfed their children who were 2 years and above. This must be a direct product of combined efforts put through BFHI programmes, UNICEF and WHO programmes in Nigeria.

Generally, the consumption of antioxidant vitamins – rich foods in Aguata L.G.A was discovered to be high but the bioavailability of the vitamins were highly reduced by losses due to wrong–handling, processing, and over all food preparation. The consumption of zinc–rich foods was really poor and even the little taken were from poor bioavailable sources. Intensified nutrition education, dietary diversification and fortification will surely help to improve the bioavailability of nutrients taken by 2-5 year old children in Aguata L.G.A. of Anambra State Nigeria and other developing countries at large.

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