NUTRIENT INTAKE OF CHILDREN (36months) FED FERMENTED FOODS IN URBAN AND RURAL COMMUNITIES IN ANAMBRA AND ENUGU STATES, NIGERIA.

Ibeanu, V.N
Department of Home Science, Nutrition and Dietetics P O B ox 3106 University of Nigeria, Nsukka, Nigeria.

ABSTRACT

A 3-day weighed food intake study was conducted with 200 children aged 36 months in two urban and rural communities in Anambra and Enugu states. Means, standard error of the mean and Duncan’s multiple range test were the statistical tools used to analyze the data. The daily mean energy intake, protein, thiamin, niacin, vitamin A and ascorbate were higher than 90% of the FAO/WHO/UNU (1985) and WHO (1974) requirements in the eight communities. The rural children consumed more than the urban children. The iron intake, calcium and riboflavin were generally low (<50%) across the communities. Fermented foods were the major sources of energy, niacin and thiamin intakes of the children in the eight communities. Fermented foods were poor sources of protein, iron, calcium, ascorbate and riboflavin intakes of the children. Fermented foods provided no vitamin A for the children. Home food production and fermentation boosted the overall nutrient intake of the rural children. As judged by the results, ‘backyard’ food production, nutrition education and cost effective fermentation technologies are advocated in urban areas.

Key words Children, Fermented foods, Nutrient Potentials, Urban and rural community.

INTRODUCTION

Children aged 36 months are within the complementary feeding age and at risk of protein energy malnutrition (PEM) if they are not properly fed. Inadequate intake of energy and other nutrients are known to precipitate malnutrition and growth faltering in children during complementary feeding. The impact of under-nutrition on illnesses, disability and death is substantial and under estimated. The World Bank (1993) attributed between 20 to 25% of global burden of diseases in children to under-nutrition. And about 15% of the total global disability – adjusted life years (DALYs) is due to malnutrition in general. Early growth retardation is associated with a broad range of adverse functional consequences. For example, malnutrition increases both the susceptibility to diseases (HIV infection inclusive) and vulnerability to their consequences (Thoraya, 2004). A malnourished child has higher risk of dying prematurely from disease like malaria. It has been shown that nearly 57% of malaria deaths are attributable to malnutrition (Thoraya, 2004). Studies also indicate that as much as one-third to one-half of childhood mortality from other diseases is attributable to malnutrition (Pelletier, 1994). In addition to this elevated mortality risk, delayed motor development (Pollitt, 1994) and impaired cognitive function and school performance are associated with the process of early nutritional stunting (Martorell, 1992). Children who are undernourished in early childhood have up to 15 points reduction in IQ (Martorell, 1996). Thus improvements in young children’s nutrition are desirable not only for their expected positive impact on their physical growth but to reduce the risk and complications of infection and to maximize psychomotor development and school performance. Unfortunately, feeding of children at this age is still a problem in Nigeria because our traditional complementary foods are bulky, low in energy and essential nutrient densities. The use of fermentation and germination to produce complementary foods from local staples is known to enhance the energy and nutrient content of the staples among other benefits. The potential that fermentation and germination of foods are great, however, their application in food processing in Nigeria is not encouraging. This study was designed to assess the contribution of fermented foods to the nutrient intake of...
children in urban and rural communities in Anambra and Enugu states.

MATERIALS AND METHODS

Study area: The study was conducted in four communities in Anambra and Enugu states of Nigeria. The four communities used in each state were two urban and two rural. In Enugu state, the communities were Enugu urban (ENU), Ugwogo-Nike as Enugu rural (ENR), Nsukka urban (NKU) and Obupka as Nsukka rural (NKR). In Anambra state, Enu-Onitsha as Onitsha urban (ONU), Onitsha rural (ONR), Awka urban (AKU) and Achalla as Awka rural (AKR) were the communities used.

Sample selection: The subjects consisted of 200 children aged 36 months living in 120 households. A list of households with children defined as a group of people habitually eating from the same cooking pot and sleeping under the same roof was compiled and numbered with the assistance of community leaders. Twenty households per community were selected by sampling interval and random start for the food intake study.

Data collection

Food intake study: Individual weighed food intake of the children was recorded for 3 days. The ingredients used in preparing each meal were weighed using a Way Master Dietary Scale (CMS Weights Ltd., London, Model 1005K). The meals were weighed after cooking as well as the quantity served to each child before feeding. Plate wastes were weighed and subtracted from the quantity served to determine the actual food intake of the child. The snacks consumed throughout the period by each child were also weighed. The amount of food consumed was expressed as raw food weight and estimated from the proportion of the different ingredients in the recipe. The water conversion factors were determined by averaging repeated measurements of raw and cooked foods.

Data analysis: The nutrient intakes of the children were estimated using food composition tables (Platt, 1975 and FAO, 1969). Mean daily nutrient intake, percentage contribution by the fermented foods and the adequacy of the diets were determined using recommended nutrient intakes for the age group. The means were compared using the statistical method of Analysis of variance.

RESULTS

Table 1 shows the comparative energy and protein intakes of children in Anambra and Enugu states. Both total energy and protein intakes of children in NKR were higher and significantly different (P < 0.05) from those of the other communities (1936.0kcal and 69.0g, respectively).

<table>
<thead>
<tr>
<th>Table 1. Comparative energy and protein intake of children in Anambra and Enugu States.</th>
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</thead>
<tbody>
<tr>
<td>E1= Mean daily energy intake</td>
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<tr>
<td>E2= Mean energy intake/ day from fermented foods</td>
</tr>
<tr>
<td>E3= % energy intake from fermented foods</td>
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<tr>
<td>P1= Mean daily protein intake</td>
</tr>
<tr>
<td>P2 = mean protein intake/ day from fermented foods</td>
</tr>
<tr>
<td>P3 = % protein intake from fermented foods</td>
</tr>
<tr>
<td>ONR = Onitsha rural</td>
</tr>
</tbody>
</table>

Mean ± SD of 3 determinations. Duncan’s multiple range test compared the means. Means with different superscript along the same vertical line are significantly different from each other (p<0.05)

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The energy and protein derived from fermented foods in NKR were higher and differed from those of the other communities (428.5 kcal and 4.5g, respectively). When the energy and protein intakes from fermented foods were expressed as the percentage of the total intake, the NKR had higher values than the other communities (31.7 and 18.9%, respectively). The ENR had the second highest energy and protein intake from fermented foods against others in rural communities (1345.8 kcal and 32.5g). When the values were expressed as percentage of the total intake, the ENR had the second highest values (24.2 and 12.8%). On the other hand, the children in ENU had higher total energy and protein intake than those in the other urban communities (1350.1 kcal and 30.6g) and second highest energy and protein derived from fermented foods (273.0 kcal and 2.47g). The total energy intake of the ENR was comparable to that of the ENR (P>0.05). When the intakes from fermented foods were expressed as percentage of the total intakes, the NKU had the second highest values (20.6 and 11.5%). The children in both urban and rural communities in Awka and Onitsha had the lowest total energy and protein intakes. They also had lowest energy and protein intakes from fermented foods, and when expressed as the percentage of the total intake The comparative calcium and iron intakes of children in Anambra and Enugu states are shown in Table 2. The total calcium and calcium derived from fermented foods in the four urban communities differed (P < 0.05). The values ranged from 326.3mg to 537.9mg and from 18.9mg to 38.7mg. The AKU children had more total calcium intake (537.9mg) than the other urban communities (P < 0.05). The AKU on the other hand, had the least calcium derived from fermented foods (18.2mg) and percent mean daily intake (4.2%) when compared with other urban communities (P < 0.05). The ONU had the second highest total calcium intake (386.6mg) and third percent daily mean intake from fermented foods (8.3%). The ENU and the NKU ranked third and fourth in total calcium intake (353.3 and 326.3mg, respectively). On the other hand, NKR had highest calcium intake (38.7mg) from fermented foods, followed by ENU (36.8mg). The percentages of total calcium intake in urban areas were, NKU (8.5%), ENU (8.1%), ONU (5.1%) and AKU (4.2%).

The NKR had the highest total calcium intake (661.2mg), from fermented foods (53.4mg) and percentage of total intake (11.7%) among the other rural communities (P < 0.05). The children in AKR had the second highest total calcium intake (542.8mg), and least intake from fermented foods (31.0mg) and percentage of the total intake (6.6%). ONR children had the third highest total calcium intake (348.3mg), second from fermented foods (41.6mg) and third percentage of the total intake (9.2%). ENR children consumed the least total calcium (281.5mg). However, they had the third highest (39.3mg) from fermented foods and the second (10%) percentage of the total intake.

The total iron (Fe) intake of the children in the four urban areas differed from each other (P < 0.05). The ENU had the highest total Fe intake (11.2mg), the second highest (1.6mg) from fermented foods. The ENU had the second highest when the intakes contributed by fermented foods were expressed as percentage of the total (17.%). The NKU children had the second highest total intake (10.2mg) and first in both values derived from fermented foods and its expression as the percentage of the total intake (1.8mg and 18.8%, respectively). The ONU children’s total iron intake ranked third (9.0mg) and the contribution from fermented foods and its percentage as the percentage of the total both ranked fourth (1.2mg and 13.8%, respectively). The AKU children had the least total iron intake (7.8mg). Fermented foods contributed 1.5mg, and when expressed as percentage of the total intake the value was 17.2%. The NKR children’s total iron intake was much higher than those of their counterparts (17.0mg Vs 8.6 – 15.6mg, respectively).
Means with different superscript along the same vertical line are significantly different from each other (p<0.05).

The NKU and the AKU children had the highest (1973.8 µg) vitamin A intake when compared with the other urban children. The NKU and the AKU children had 1377.2 and 1275.1 µg vitamin A and the ONU had the least (1014.3 µg). It was only the ONU children who derived some of their vitamin A from fermented foods. The value was 0.4% when expressed as the percentage of the total intake among the urban communities. In the rural areas, the ENR had the highest total vitamin A intake (4325.2 µg) followed by the AKR (985.0 µg), the ONR and the NKR (432.0 and 239.9 µg) respectively. Only the NKR children obtained some of their vitamin A from fermented food (10.7 µg). This was about 3% of the total intake. Across the eight communities studied, the ENR children had the highest total vitamin A intake (P<0.05). The four urban communities (ENU, NKU, ONU and AKU) and one rural community (AKR) had comparable intakes.

The thiamin values for both the urban and rural children varied (P<0.05). Surprisingly, the ONU had the highest total thiamin intake (14.7mg). Enugu and Nsukka urban each had 0.8mg and the AKU had the least value (0.5 mg). The ENU, the NKU and the NKR children had 10.5%. The NKR and the ENR had the same percentage intake (20.1%) from fermented foods. The ONU had 14.7% and the AKU had 10.5%. The NKR and the ENR had the

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### Tables

#### Table 2. Comparative calcium and iron intake of children in Anambra and Enugu states.

<table>
<thead>
<tr>
<th>Communities</th>
<th>Ca1 (mg)</th>
<th>Ca2 (mg)</th>
<th>Ca3 (%)</th>
<th>F1 (mg)</th>
<th>F2 (mg)</th>
<th>F3 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENU</td>
<td>353.3 ± 38.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>36.8 ± 4.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.1 ± 1.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11.2 ± 1.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.6 ± 0.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17.0 ± 1.7&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>ENR</td>
<td>281.5 ± 41.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>39.3 ± 8.2&lt;sup&gt;d&lt;/sup&gt;</td>
<td>10.0 ± 2.4&lt;sup&gt;d&lt;/sup&gt;</td>
<td>15.6 ± 3.2&lt;sup&gt;d&lt;/sup&gt;</td>
<td>2.1 ± 0.4&lt;sup&gt;c&lt;/sup&gt;</td>
<td>22.1 ± 4.6&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>NKU</td>
<td>326.3 ± 35.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>38.7 ± 6.1&lt;sup&gt;c&lt;/sup&gt;</td>
<td>8.5 ± 1.4&lt;sup&gt;d&lt;/sup&gt;</td>
<td>10.2 ± 0.8&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1.8 ± 0.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>18.8 ± 1.8&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>NKR</td>
<td>661.2 ± 42.4&lt;sup&gt;d&lt;/sup&gt;</td>
<td>53.4 ± 12.8&lt;sup&gt;c&lt;/sup&gt;</td>
<td>11.7 ± 2.9&lt;sup&gt;c&lt;/sup&gt;</td>
<td>17.0 ± 2.1&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.9 ± 0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28.5 ± 5.6&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>AKU</td>
<td>537.9 ± 18.7&lt;sup&gt;c&lt;/sup&gt;</td>
<td>18.9 ± 3.2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.2 ± 0.7&lt;sup&gt;d&lt;/sup&gt;</td>
<td>7.8 ± 0.9&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1.5± 0.4&lt;sup&gt;c&lt;/sup&gt;</td>
<td>17.2± 4.2&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>AKR</td>
<td>542.8 ± 63.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>31.0 ± 5.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.6 ± 1.1&lt;sup&gt;d&lt;/sup&gt;</td>
<td>10.1 ± 1.1&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1.5 ± 0.5&lt;sup&gt;c&lt;/sup&gt;</td>
<td>15.9 ± 2.2&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>ONU</td>
<td>386.6 ± 48.5&lt;sup&gt;c&lt;/sup&gt;</td>
<td>24.0 ± 6.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.3 ± 1.4&lt;sup&gt;c&lt;/sup&gt;</td>
<td>9.0 ± 1.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.2± 0.2&lt;sup&gt;d&lt;/sup&gt;</td>
<td>13.7 ± 2.7&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>ONR</td>
<td>348.3 ± 46.1&lt;sup&gt;1&lt;/sup&gt;&lt;sup&gt;b&lt;/sup&gt;</td>
<td>41.6 ± 6.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>9.2 ± 1.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8.6 ± 0.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.9± 0.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>21.7± 3.6&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Ca1= Mean daily calcium intake
Ca2= Mean calcium intake/day from fermented foods
Ca3= % calcium intake from fermented foods
F1= Mean daily iron intake
F2= Mean iron intake/day from fermented foods
F3= %iron intake from fermented foods
ENU = Enugu urban
ENR = Enugu rural
AKU = Akwa urban
AKR = Awka rural
NKU = Nsukka urban
NKR = Nsukka rural
ONR = Onitsha rural
ONU = Onitsha urban

Mean ± SD of 3 determinations. Duncan’s multiple range test compared the means.

Means with different superscript along the same vertical line are significantly different from each other (p<0.05)

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Iron intake in NKR from fermented foods and its expression as percentage of the total intake were also much higher than those of their counterparts (2.9mg and 28.5%).

The ENR had second highest total iron intake (15.6mg), the intake from fermented foods (2.1mg) and its expression as percentage of the total intake (22.1%). The NKR had the third highest total intake (10.1mg) and the lowest intake from fermented foods (1.5mg) as well as the percentage of the total intake (15.9%). On the other hand, ONR had the least total iron intake (8.6mg) and ranked third in both contribution from fermented foods and its expression as percentage of the total intake (19.9mg and 21.6%).

The NKR children had significantly more total calcium and iron intake and those derived from fermented foods than the other eight communities (P < 0.05). However, some urban and rural communities had comparable total intake of the two minerals (P> 0.05). The comparative vitamin intake of children in Anambra and Enugu states is shown in Tables 3a and b. The ENU children had the highest (1973.8µg) mean vitamin A intake when compared with the other urban children. The NKU and the AKU children had 1377.2 and 1275.1 µg vitamin A and the
highest total thiamin intake (2.8mg and 1.4mg, respectively) amongst the rural communities studied. The AKR and the ONR on the other hand had 0.7mg and 0.5mg, respectively). The thiamin derived from fermented foods was: ENR (0.2mg), NKR (0.1mg), AKR (0.1 mg) and ONR (0.07mg). These values were 16.9%, 25.9%, 17.5% and 11.2% of the total intake, respectively.

The riboflavin values for the four urban and rural communities were very interesting and revealing. The ONU had the highest total riboflavin intake (1.5mg), followed by the AKU (0.62mg). The ENU and NKU had 0.6mg. The contribution of riboflavin from fermented foods was low. The values for urban communities ranged from 0.02 – 0.06mg. The AKU had the least (0.02mg) and the NKU had the highest (0.06mg). When the intake from fermented foods in each community was expressed as percentage of the total, the NKU and the ONU children had the highest values (7.0% and 5.1%, respectively). On the other hand, the ENU and the AKU children had 3.5% and 1.8%, respectively. In the rural communities, NKR children consumed more total riboflavin (0.8mg) when compared with others. The ENR, the AKR and the ONR had comparable values (0.46mg, 0.42mg and 0.43mg respectively). However, the percentage of the total, derived from fermented foods had different value viz 13.3% (highest), 5.01% and 4% (NKR, ENR and ONR, respectively). The AKR children consumed the least (2.5%).

The ENU had the highest mean niacin intake (7.77mg) as against the other urban communities (4.3mg – 6.9mg). The NKU had higher niacin intake (0.8mg) from fermented foods than any other urban area (0.4mg – 0.7 mg). However, when these values were expressed as percentage of the total intake, the NKU consumed more (9.1%) followed by the ENU (7.0%), the ONU (5.1%) and the AKU (3.7%). The highest niacin consumption among the rural population was the NKR children. The ONR had the second highest value (5.9mg) followed by the ENR and the AKR (5.4mg and 5.2mg, respectively. The NKR consumed more niacin (1.3mg) from fermented foods followed by the ONR (1.0mg), the ENR (0.9mg) and the AKR (0.7mg). When these values were expressed as the percentages of total intakes, the NKR had 15%; the ENR 9.9%, the ONU 10% and the AKU 7.5%.

More ascorbate was consumed by the NKU children than any other urban communities (62.0 Vs 39.5mg, 29.0mg and 48.67mg, for the ENU, the AKU and the ONU, respectively). Fermented foods did not contribute much to ascorbate intake of the children in urban communities. The ENR had more ascorbate intake (62.0mg) when compared with the other rural communities (62.0mg Vs 48.6mg 29.7mg, and 27.1mg for the NKR, AKR and ONR, respectively). Only two rural communities (NKR and AKR) had ascorbate (2.3mg and 0.03mg, receptively) from fermented foods. The intake from fermented foods in these two communities was 0.2% for AKR and 11.6% for NKR.
Table 3a. Comparative vitamin A, thiamin and riboflavin intake of children in Anambra and Enugu states.

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>ENU</th>
<th>ENR</th>
<th>NKU</th>
<th>NKR</th>
<th>AKU</th>
<th>AKR</th>
<th>ONU</th>
<th>ONR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vit.A1</strong> (µg)</td>
<td>1973.8±279.2b</td>
<td>4323.2±742.8a</td>
<td>1377.6±162.6b</td>
<td>239.9±46.3c</td>
<td>174.1±198.3bc</td>
<td>1014.3±173.5bc</td>
<td>1041.3±173.5bc</td>
<td>432.0±43.4d</td>
</tr>
<tr>
<td><strong>Vit.A2</strong> (µg)</td>
<td>0±0</td>
<td>0±0</td>
<td>0±0</td>
<td>0±0</td>
<td>0±0</td>
<td>0±0</td>
<td>0±0</td>
<td>10.7±10.7a</td>
</tr>
<tr>
<td><strong>Vit.A3</strong> (%)</td>
<td>0±0</td>
<td>0±0</td>
<td>0±0</td>
<td>3.1±3.1b</td>
<td>0±0</td>
<td>0±0</td>
<td>0±0</td>
<td>0±0</td>
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<tr>
<td><strong>Thia.1</strong> (mg)</td>
<td>0.8±0.1c</td>
<td>1.4±0.5c</td>
<td>0.8±0.1c</td>
<td>2.8±1.3b</td>
<td>0.5±0.1c</td>
<td>0.8±0.1c</td>
<td>14.7±12.6c</td>
<td>0.5±0.1c</td>
</tr>
<tr>
<td><strong>Thia.2</strong> (mg)</td>
<td>0.1±0.1</td>
<td>0.2±0.1</td>
<td>0.1±0</td>
<td>0.1±0</td>
<td>0.07±0</td>
<td>0.1±0</td>
<td>0.1±0</td>
<td>0.07±0</td>
</tr>
<tr>
<td><strong>Thia.3</strong> (%)</td>
<td>20.1±9.7b</td>
<td>16.9±3.8b</td>
<td>19.9±8.5b</td>
<td>25.9±7.5a</td>
<td>10.5±4.4d</td>
<td>17.5±5.3b</td>
<td>14.4±5.8c</td>
<td>11.2±1.8d</td>
</tr>
<tr>
<td><strong>Ribo.1</strong> (mg)</td>
<td>0.6±0.1b</td>
<td>0.5±0.1b</td>
<td>0.6±0.1b</td>
<td>0.8±0.1b</td>
<td>0.6±0.1b</td>
<td>0.4±0.1</td>
<td>1.5±0.5b</td>
<td>0.4±0.1b</td>
</tr>
<tr>
<td><strong>Ribo.2</strong> (mg)</td>
<td>0.03±0.0b</td>
<td>0.04±0.0b</td>
<td>0.06±0.0b</td>
<td>0.12±0.0b</td>
<td>0.02±0</td>
<td>0.02±0</td>
<td>0.05±0b</td>
<td>0.04±0b</td>
</tr>
<tr>
<td><strong>Ribo.3</strong> (%)</td>
<td>3.5±0.4c,d</td>
<td>5.1±2.1b</td>
<td>7.0±1.9b</td>
<td>13.3±3.7a</td>
<td>1.8±0.2d</td>
<td>2.5±0.5d</td>
<td>5.1±2.2b</td>
<td>4.0±0.7b</td>
</tr>
</tbody>
</table>

Vit.A1= Mean daily vitamin A intake
Vit.A2= Mean vitamin A intake/day from fermented foods
Vit.A3= % vitamin A intake from fermented foods
Thia.1= Mean daily thiamin intake
Thia.2= Mean thiamin intake/day from fermented foods
Thia.3= % thiamin intake from fermented foods
Ribo.1= Mean daily riboflavin intake
Ribo.2= Mean riboflavin intake/day from fermented foods
Ribo.3= % riboflavin intake from fermented foods

Mean ± SD of 3 determinations. Duncan’s multiple range test was used to compare means
Means with different superscript along the same vertical line are significantly different from each other (p < 0.05)
Table 3b. Comparative niacin and ascorbate intake of children in Anambra and Enugu states

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>ENU</th>
<th>ENR</th>
<th>NKU</th>
<th>NKR</th>
<th>AKU</th>
<th>AKR</th>
<th>ONU</th>
<th>ONR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niacin1</td>
<td>7.8±</td>
<td>5.4±0.5b</td>
<td>5.9±</td>
<td>10.9±</td>
<td>4.3±0.6c</td>
<td>5.2±</td>
<td>7.0±1.4b</td>
<td>5.9±</td>
</tr>
<tr>
<td>(mg)</td>
<td>1.5b</td>
<td>0.6b</td>
<td>1.4a</td>
<td>0.5b</td>
<td>0.8b</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Niacin2</td>
<td>0.7±</td>
<td>0.9±0.2a</td>
<td>0.8±</td>
<td>1.2±</td>
<td>0.36±</td>
<td>0.7±</td>
<td>0.5±0.1d</td>
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</tr>
<tr>
<td>(mg)</td>
<td>0.1d</td>
<td>0.1a</td>
<td>0.2a</td>
<td>0.1c</td>
<td>0.1d</td>
<td>0.1a</td>
<td>0.1</td>
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<tr>
<td>Niacin3</td>
<td>7.0±</td>
<td>9.9±1.8b</td>
<td>9.1±</td>
<td>15.0±</td>
<td>3.7±0.6</td>
<td>7.5±</td>
<td>5.1±1.2b</td>
<td>10.0±</td>
</tr>
<tr>
<td>(%)</td>
<td>1.0b</td>
<td>1.7b</td>
<td>2.6a</td>
<td>1.5b</td>
<td>1.4b</td>
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<tr>
<td>Asco.1</td>
<td>39.5±</td>
<td>62.0±</td>
<td>62.0±</td>
<td>48.6±</td>
<td>29.0±</td>
<td>29.7±</td>
<td>48.7±</td>
<td>27.1±</td>
</tr>
<tr>
<td>(mg)</td>
<td>3.8a</td>
<td>20.6a</td>
<td>5.84a</td>
<td>7.0a</td>
<td>5.3b</td>
<td>10.0b</td>
<td>7.1</td>
<td>5.2b</td>
</tr>
<tr>
<td>Asco.2</td>
<td>0±0</td>
<td>0±0</td>
<td>0±0</td>
<td>2.3±</td>
<td>0±0</td>
<td>0.03±</td>
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<tr>
<td>(mg)</td>
<td>2.3a</td>
<td>0.0b</td>
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<tr>
<td>Asco.3</td>
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<td>0±0</td>
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<td>0.1b</td>
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Niacin1 = Mean daily niacin intake
Niacin2 = Mean niacin intake/day from fermented foods
Niacin3 = % niacin intake from fermented foods
Asco.1 = Mean daily ascorbate intake
Asco.2 = Mean ascorbate intake/day from fermented foods
Asco.3 = % ascorbate intake from fermented foods
ENU = Enugu urban
ENR = Enugu rural
NKU = Nsukka urban
NKR = Nsukka rural
AKU = Awka urban
AKR = Awka rural
ONU = Onitsha urban
ONR = Onitsha rural

Mean ± SD of 3 determinations. Duncan’s multiple range test was used to compare the means.
Means with different superscripts along the same vertical line are significantly different from each other (p < 0.005)

DISCUSSION

Food intake of children and the nutrient contribution of fermented foods to it

The high energy, protein, thiamin, vitamin A, niacin and ascorbate intakes of the children from sources other than fermented foods were due to: (a) high consumption of starchy staples and fat, (b) prolonged breastfeeding during the transition period, and (c) frequent feeding of complementary foods.

It is known that increased meal frequency increases energy intake in children (WHO, 1998). Fermented foods contributed to the energy intake of the children in the states, especially in rural communities. This is probably due to frequent consumption of fermented foods. This is similar to the findings of Onofioik et al. (1996). It was reported that rural communities had higher total energy intake and also higher percentage from fermented foods. The absence of underweight in rural children was indicative of increases in both linear growth and weight. Such increases were reported in Guatemala (Stoltzfus et al., 1996).
The result of a 1990 demographic and health survey in Nigeria (DHS/IRD Macro system, 1992) showed that underweight was higher among rural children than urban children. This is at variance with this study because of the high energy intake of the rural children. This high energy intake of the rural children might be attributed to rural mothers production of greater percentage of foods they consumed in their homes. This is in contrast to the urban mothers who purchased most of their foods from the market at high cost.

The high protein intake in both urban and rural communities led to no growth–faltering. The high protein intake in the urban communities was due to consumption of animals and their products. The high protein intake in the rural communities might be attributed to consumption of blends of legumes and starchy staples. This confirmed the results of some studies (Oyeleke et al., 1995). Fermented foods contributed less to protein intake of the children because they consumed mostly starchy staples which are low sources of protein as reported earlier (WHO, 1998).

The relatively high calcium and iron intakes of the rural children were due to high consumption of blends of legumes/seeds as food and condiments. The high calcium intake in urban communities was due to (a) addition of milk to their porridges and (b) consumption of legume/seed and its condiments. The low iron and calcium intakes from fermented foods were due to inadequate intake of legume/seed – based condiments, milk and its fermented products in the diets. Fermented foods were not sources of vitamin A intake of the children. The over 300% of the FAO/WHO/UNU (1995) requirement of total vitamin A intake observed in the children was due to addition of red palm oil to mashed yam consumed. This result agrees with the findings of Ifudu and Obizoba (1986) in their study of the motherless baby’s homes in Enugu state. They observed that the vitamin A intake of the children was high and attributed it to high consumption of raw red palm oil.

The high intakes of thiamin and niacin of children in both rural and urban communities of the two states were because the children consumed fermented foods that were good sources of these nutrients. These nutrients are synthesized by microflora during fermentation. The low levels of riboflavin and ascorbate from fermented foods could be that the foods the children consumed were not good sources of the nutrients regardless of fermentation. The fair levels of these two vitamins were from sources other than fermented foods.

**CONCLUSION**

This study demonstrated that fermented foods are popular in both urban and rural communities of Anambra and Enugu states as complementary foods for children. Development of cost effective and improved fermentation technologies would promote production and Consumption of fermented complementary foods especially in urban areas. This would create labour saving opportunities. Poor economy, lack of nutrition education and absence of home gardens precipitated the lower dietary intake in the urban dwellers. Nutrition education is the key to improve nutrient intake in both rural and urban communities.

**REFERENCES**


