4. PROGRESS REPORT FROM THE NUTRITION UNIT

NUTRITION UNIT

PROGRESS REPORT ON PROGRAMME IMPLEMENTATION

1986 - 1990

INTRODUCTION

Nutrition Unit was established as a separate unit of the Institute in 1986. Until then, its actvities were carried out within Chemical Pathology Unit.

According to the Tentative Implementation Programme of the institute for 1986/87 - 1990/91, the objectives of the unit are:

1. to train the staff to carry out analysis of nutrients in food, blood and body tissues.
2. to improve the nutritional status of the infant through appropriate weaning foods.
3. to determine the incidence of Vitamin A deficiencies and anaemia.

The research programmes specifically outlined are:

a. Technical training for blood, tissue and food analyses

b. Weaning food and protein-energy-malnutrition

c. Vitamin A and other vitamin deficiencies,

d. Nutritional status possibly aggravated by intestinal parasitism

e. Immunosuppression related to Nutritional deficiencies, and

f. Iron and other mineral dificiencies

In addition, there is a provision for counterpart training in Japan as well as the attachment of Japanese Scientists to the unit, and provision of equipment/chemicals/reagents needed in the unit.

2. TECHNICAL TRAINING FOR BLOOD,TISSUE AND FOOD ANALYSES

This is being done in Ghana and Japan. In Ghana, the training is on-the-job, and materials (food, blood and tissues) used in Research serve as materials for training.

Training overseas with JICA support is also being pursued. Mr. E.A. Addo, a senior technician returned to the unit in June 1988 after a year's study in Japan on Vitamin A and anaemia. Miss Yartey returned from Japan in January 1990 after a year's training where she completed her practical work for the award of M.Phil degree by the University of Ghana.

Dr. M. Armar-Klemensu who was supported by UN University in her Ph.D studies in the London School of Hygiene and Tropical Medicine, returned to the unit in October, 1989.

Mr. E. Quansah, a technician of the unit has been officially nominated to undergo a year's training in Analytical techniques in Japan. He is due to leave shortly.

Dr. E.E.K. Takyi, a senior Research Fellow also undertook a 5-week educational tour of Japan in May-June 1989 with JICA support, to learn at first hand, of the research activities and management of Medical Institutes in Japan. He spent a week working (in the laboratory of Professor Masushige at the Tokyo Agricultural University) on vitamin B_1 and B_2 analyses.

3. JAPANESE EXPERTS

Since 1986, the following Japanese Scientists have been attached to the unit, for the times indicated:

1.	Dr. S. Yamamoto	- 1986	- Sept.	1987
2.	Mr. T. Furusho	- Sept. 1987	- Sept.	1988
3.	Dr. F. Shizuka	- Sept. 1988	- Sept.	1989
4.	Dr. T. Rikimaru	- Oct. 1989	- Oct.	1990
5.	Mr. Y. Kido	- Apr. 1990	- Present.	

All these Scientists participated in the various research activities which went on during their stay.

. EQUIPMENT; About 90% of the equipment requested from JICA have been received.

5. RESEARCH PROJECTS - SUMMARY

5.1. Protein-Energy Malnutrition (PEM)

5.1.1. Weaning Foods

This study, which started in 1986, has been carried out in phases.

In phase 1, studies were carried out in Greater Accra, involving 202 children aged between 12 and 24 months to find possible cause(s) for malnutrition.

It was found that prolonged breast feeding (more than 12 months) owing to partial refusal of supplementary diet could be one of the causes of malnutrition in the villages studied.

A paper entilted "Does Prolonged Breast-feeding Adversely Affect A child's Nutritional status? has been published (Lancet, August 1988, pp414 - 418)

Phase 2 was planned to investigate:

i. whether there could be a correlation between the time children are introduced to supplementary foods and rejection of supplements, if this takes place,

ii. whether the type (quality) of weaning food given could affect its acceptance or rejection in children who are being weaned.

The children were put on one of the supplements listed below, at a time, with the exception of group 4, where children could be put on any ration at a time.

i. Maize porridge - Infants were fed on this diet by their own mothers

ii. Maize porridge + milk

iii. Weanimix (Corn + groundnuts; 4:1 w/w)

iv. Variable feeding pattern

Acceptance or rejection of supplements were recorded during 2 weekly interviews of mother. Growth was monitored by anthropometric measurements.

It was found out that regardless of the type of weaning food given, rejection stil occurred.

Full Report: Full report on this study is presented as an appendix to this report.

5.1.2. Possible Incorporation of Alfalfa Into Supplementary Foods of Children

Our unit has embarked on some studies to determine the possibility of incorporating Alfalfa (as nutrient cake) into supplementary diets of children, because of its relatively excellent properties, with respect to high protein content, B-Carotnee and mineral levels.

The project is in 2 phases:

i. Phase 1 - Animal Feeding studies

ii. Phase 2 - Child feeding

Phase 1 has been 95% completed. Phase 2 is yet to begin.

Summary of Phase 1 Studies

Aim: To compare the development of rats (as indicated by body weight gains and haematological changes) fed on Alfalfa diet with those fed on weanimix - a popular weaning diet.

Experimental

Different rats were fed for 4 weeks on either

i. normal rat stock diet

ii. Alfalfa nutrient cake:roasted corn (1:4 w/w) or

iii. Weanimix (roasted groundnuts:roasted corn (1:4 w/w).

During the feeding period, food and water intake, body weight, tail length and general behaviour of the rats were monitored. At the end of the feeding priod, rats were sacrificed and the blood examined with respect to Hb, PCV, WBC (total and differential) and RBC levels.

Results

i. Rats fed on weanimix diet consumed less feed (3066g/4 weeks) as compared to those fed on stock diet (3673.9g) and Alfamix (3876.8g).

ii. Male rats fed on stock diet gained the highest weight followed by those fed on Alfalfa. Significantly less weight was gained by rats fed on weanimix.

iii. Female rats fed on Alfalfa gained marginally more weight than those fed on stock diet. Here too, females fed on weanimix gained significantly less weight.

iv. Food efficiency ratios indicate the following order of conversion to body weight: stock diet> Alfamix > weanix

Conclusion: Alfalfa (as Alfamix) supports growth as (measured by gain in body weight) in rats, better than weanimix

Full Report: Full report is presented as an appendix to this report.

5.2. Studies On Vitamin A

Two (2) groups of studies were carried out:

i. Prevalence study - to determine the status of Vitamin A in the inhabitants of Gomoa Onyadze.

ii. Analysis of B-Carotene levels in local foodstuffs.

I. Prevalence Study

Fasting blood was withdrawn from 263 inhabitants (randomly selected) and the vitamin A (by HPLC), Retinol Binding Protein (RBP) and Pre-albumin (by radial immunodiffusion techniques) levels determined.

Other parameters - protein, glucose and triglycerides were determined using routine methods.

Results indicate that:

i. In the 3-5 year olds (n=47) 4.2% had vitamin A levels of less than 10ug/dl (normal acceptable level is 20-50ug/dl), representing a group deficient in vitamin A. 14.9% had levels of 10-20ug/dl = low level group; 80.9% had adequate amounts of 20-50ug/dl; none of the subjects had levels higher than 50ug/dl.

ii. In the 6-14 year olds (n=97) none had deficient levels of less than 10ug/dl; 16.5% had low levels of 10-20ug/dl; 82.5% had adequate level of 20-50ug/dl and 1% had high level (ie more than 50ug/dl)

iii. In the 15-45 year group (n=101) none had deficient level; 6.9% had low levels of 10-20ug/dl; 86.1% had adequate level of 20-50ug/dl and 6.9% had high levels (more than 50ug/dl)

iv. In the older age group (more than 45 year old) (n=18) none had deficient level; 5.5%, 83.3% and 11.1% of the subjects, respectively, had low, adeaquate and high levels.

v. RBP and prealbumin levels increased with increased vitamin A levels.

Conclusion:

Since the deficient group is less than 5% of the total group screened, there is no vitamin A deficiency in Bomaa Onyadze. 5% level has been set up by WHO as the cut off point to determine whether or not there is vitamin A deficiency in a target population. In the present study, only 0.80% were found deficient in Vitamin A.

5.2.2. Analyses of Foodstuffs For B-Carotene Levels

This part of the work is currently in progress. Up to date, analysis has been completed for fats and oils, and leafy vegetables.

Results

i. B-carotene level found in different types of palm oil was 69600 -95000ug/100g.dl

ii. Coconut oils had levels at 8-53ug/100g.

iii. Palm kernel oils had levels of 10-100ug/100g.

Leafy Vegetables

i. Fresh wild lettuce had levels of 17000ug/100g while boiling reduces it to 1700ug/100g.

ii. Fresh kontomire had levels of 5200ug/100g, reducing to 600ug/100g upon boiling.

iii. Dry and powdered leafy vegetables from the northern parts of Ghana had levels of 302ug/100 to 7000ug/100g.

Conclusion

Of the oils screened, palm oil is the richest source of B-carotene.

All the leafy vegetables screened had appreciable amounts of B-carotene but care should be taken during food preparation so as not to destroy the B-carotene. This work has shown that even simple boiling leads to a reduction to 10% of the fresh values.

Full Report: Full report of this work is enclosed as an appendix.

5.3. Studies On Oral Rehydration Salts

Three (3) types of activities have been carried out in this field of study:

i. Quality assurance test of UNICEF ORS Sachets

ii. Chemical evaluation of Home-available fluids used in management of diarrhoea (Oral Rehydration therapy)

iii. KAPB analyses of ORS and their use.

i. Quality Assurance of UNICEF Sachets

It has been observed that the content of some of the UNICEF ORS sachets turn yellowish on storage for 2 years or more. UNICEF therefore requested us to screen the coloured samples to see if their chemical composition still conforms to the original specification. It is important that there should not be any significant deviation from the original composition, if there sachets are to remain effective in rehydration.

Results of analyses of about 30 samples revealed that except in highly coloured samples, where the levels of HCO^{3--} and glucose are marginally reduced (by 10%), there was no charge in any of the coloured samples.

It was seen that a trained eye could easily determined whether or not a coloured 'sachet' was suitable. The sachets to be discarded were found to contain highly coloured and lumpy mixtures.

ii. Evaluation of local ORS

Various localities in Ghana have developed their own ORS for use during outbreak of diarrhoea. Some of these include extracts from (i). leaves, such as (a). guava, (b). mango bark, (ii). cereal-based porridges such as (a). rice water (b) water used to cook kenkey and (iii). banana and ripe plantain. However up to date, there has been no analysis of these extracts to know their chemical composition. This unit has therefore carried out chemical analysis of some of these extrcts so as to find the scientific basis of their use.

The following analyses were carried out:

i. Sugars (somogyi - Nelson method)

ii. Chloride - by Argentometric titration;

iii. Sodium and Potassium - by Atomic Absorption Flame photometry;

iv. pH - pH meter.

Results and Discussions

1. PH- It was seen that all the 3 ORS analysed are acidic as compared to UNICEF specifications, which is largely basic.

2. Simple sugars: Both kenkey water (1.8g/l) and rice water (0.4g/l) contain only trace amounts of glucose when compared to UNICEF specification (20g/l); however coconut juice (46.1g/l) contain about twice the recommended level. The level of glucose in the deficient mixtures can be adjusted by adding some sugar (sucrose) which is almost available in every home in Ghana.

3. Na+: - All the 3 mixtures contain significantly less sodium when compared with UNICEF specification. In the case of coconut juice, the short-fall can be 'adjusted a bit'by addition of some amounts of common salt and this should not present any problems since the cl- levels (65mmol/l) are also below the recommended level (74.4-85.6mmol/l).

4. K+: Kenkey water contain adequate amounts of K+, while rice water (2.1mmol/l) contain inadequate amounts and coconut juice contain excessive amounts (73.6mmol/l). The recommended level is 20.1mmol/l.

5. Cl-: Both kenkey water and ricewater contain more than adequate amounts of cl- ions reflecting the amount of salt (Nacl) used in their preparation). Coconut juice contain marginally less amounts, but this can be adjusted by adding a 'pinch' of salt. Recommended level is 94.6mmol/l.

iii. KAPB analyses

Questionnaires were designed to find out the knowledge, attitude, practices and beliefs of some mothers concerning the use of UNICEF and local ORS in the management of diarrhoea.

Q1. Results indicate that of a total number of 173 mothers interviewed 171(98.8%) know what diarrhoea is, that is they are able to recognise when their children have diarrhoea.

Q2. Results of this questionnaire indicates that of the 176 mothers interviewed, 158 (89.8%) know about and or seen ORS while only 18(10.2%) have not heard and/or seen ORS before.

Q3. Results indicate that of a total number of 179 mothers interviewed, 60 (35.1%) of them send their children to clinic when they have diarrhoea, (33%) prepare and use salt-sugar solutions; (29%) use UNICEF ORS sachets;equal equal numbers

of them ie (17%) use either drugs or home-available fluids, while 11(3.9%) use Enema. These results (percentages) indicate that mothers usually give combined treatments when children have diarrhoea.

Q4. Of a total number of 36 mothers who use various home-available ORS, 10(27.8%) use coconut water (juice), 5 each (13.9%) use either rice water, kenkey water, boiling water extract of guava leves or other foods; 3(8.3%) use fruit juices such as 'fanta' while 2(5.6%) use maize porridge and 1(2.8%) use millet porridge.

Q5. Of the 83 (Out of a total number of 158 women interviewed) who use UNICEF ORS to manage diarrhoea in their children, 50.6% have reported a duration time of 1-2 days; 30.1%, a duration time of 3-4 days; 8.4% a duration time of 5-6 days, 9.6% a duration time of 7-8 days, while 1.2% have a duration time of 9-10 days.

Of the 3 that use rice water, 66.7% and 33.3% have reported a duration time if 1-2 and 3-4 days, respectively. Two mothers who use salt solution report a duration period of 1-2 day while 50% each of 2 women who use coconut juice report a duration period of 1-2 and 3-4 days respectively.

Twelve (12) mothers who us sugar-salt solutions have reported a duration period of 1-2 days and 3-4 days, respectively, while periods of up to 10 days were experienced by mothers who use drugs.

Q6: Of the 156 mothers interviewed, 108(69.2%) report that their children readily accept the various ORS; 12 (7.7%) accept it reluctantly while 36(23.1%) had to be forced.

Q7. Eighty (80) of a total of 143 women interviewed report that their children do not eat well during diarrhoea epidsodes, while 63 (44.1%) think that their children eat well.

Q8. 75.7%(112 out of 148) of mother interviewed found UNICEF ORS effective and woud therefore recommend its use to other mothers, while 36 (24.3%) think otherwise.

Q9: Out of 152 mothers interviewed, 1 (one) report a diarrhoea occurrence of 1-2 times in a week; 42 (27.6%) report of 1-2 occurrences/month while 4(2.6%) report of 3=4 occurrances/month. In a year, 62(40.8%) had 1-2 episodes,

28(18.4%) had 3-4 episodes, 14(9.2%) had 5-6 episodes and 1(0.7%) had 7-8 episodes.

Full Report: A full report is attached as an appendix.

5.5. Nutritional Status of Children in Rural Communities in Upper East Region of Ghana

Phase 1

Title: Nutritional status of children in a rural community Upper East Region of Ghana.

Place of study: Binaba

Date study commenced: January, 1989

Date study was completed: October, 1989

Summary of work

Introduction

The higher incidence of marasmus as compared to kwashiorkor in the Northern part of Ghana (1987 Annual Report of Bawku Rural Health Services) indicates the generally poor

food situation, in that part of Ghana. It is also believed that the incidence of eye ailments is the result of more frequent consumption of food rich in provitamin A in the south. However, up to date, no data have been collected to ascertain these observations.

This survey was carried out to evaluate the nutritional status of children in Binaba, a typical village in the Upper East Region of Ghana.

The indicators used for the determination of the nutritional status were food intake and anthropometry.

Objectives

1. To determine the dietary intake of the population aged 3-20 years.

2. To determine anthropometric parameters of the population aged 3-20 years.

Project site: Binaba Health Centre, Binaba, Upper East Region. Binaba is about five kilometers square, in area, and has about 200 houses. It is about 50km east of Bolgatanga, the regional capital.

Experimental

Dietary Survey:

Twenty-seven (27) families living around the field station were randomly selected. Daily dietary intake for 3 continuous days of all members of family, excluding breast-fed babies, was recorded by an investigator staying in the selected house.

Weights of all ingredients, including water used for meal preparation together with the weight of prepared meals, were recorded, using kitchen scales. Dietary intake for each person was calculated as the difference between initial and final weight of all meals eaten, ie before and after food consumption.

Daily intake of each ingredient was calculated from the ratio in the cooked food. Food composition tables and/or values obtained from our laboratory analysis of foods were used to calculate energy and nutrient intakes.

Anthropometric Measurements

Body weight, length or height, and arm circumference of

all the subjects in the study, were measured and compared to reference values using Harvard standard (for 1-5 years old) and Iowa standards (for 6-14 years old).

Demographic data:

About 200 heads of families were interviewed for the collection of demographic information of Binaba.

Results:

1. Demography:

   i. Results indicate that more than half of the households have 6-15 members.

   ii. About 43% of the population are aged 0-12 years

   iii. Over 70% of the adult population are small scale farmers.

   iv. Literacy rate is about 32%.

2. Anthropometry:

Mean body weights were found to be 67-84% of Harvard (for 2-5 years) and Iowa (6-12 years) standards. In the case of height, the values are 88-96% of the above standards.

3. Dietary Intake:

The mean energy intakes for all the different ages did not vary much, being 1266-1639 Kcal which is about 44-70% of the RDA values (Recommended Dietary Allowance, published by FAO/WHO).

The mean total Protein intake for 4-12 year olds was 44.63g, representing 103.19% of RDA values (ie 44.63/43.25) while it is 81.45% of RDA values (ie 45.75/56.17) for those above 12 years. Millet, the staple food at this village, contributed about 50% of total protein consumed and animal protein constituting about 6%.

4. Mineral Intake:

Calcium intake was 62-88% of RDA values, while iron intake about 200% of RDA value in 4-12 years old and 87-230% in old group.

Vitamin intake - vitamin B^1 (thiamine) intake was

generally higher than RDA values, about 117% of RDA while riboflavin (B^2) intake was very low - 28.3% of RDA values.

Niacin intake, was, on the average, 63.8% of RDA while vitamin C (Ascorbic acid) intake was about 60%. Mean vitamin A (Retinol) intake was 81% of RDA in 4-12 year olds and 49% in older age group.

Discussion:

Results of this study confirm that energy and most of the nutrient intakes were below RDA values.

Although the total amount of protein consumed is comparable to RDA, the quality is poor, lacking essential amino acid such as lysine and tryptophan. Ingested protein therefore cannot be fully utilized to maintain adequate growth under insufficient energy intake, as evidenced from relatively low values of anthropometric measurements. Low energy and nutrient intakes are an indication of the relatively poor dietary situation in northern part of Ghana.

A favourable observation made during the field work was the frequent use ofleave (fresh ones in the rainy season and dry ones in dry season), groundnuts and melon seeds.

Since the vitamin A intake was low despite the free use of leaves in preparation, it could be that the method of food preparation drastically affected (reduced) the provitamin A content of the prepared foods. There is therefore a need to educate the mothers on the method of food preparation so as to raise provitamin A content of prepared diets.

Full Report:

Full report of this study is attached as an appendix.

Phase 2:

Title: Nutritional Status of Pre-school children in rural Upper East Ghana.

Places of Study: 3 villages (excluding Binaba) in Upper East Region,

Date Commenced: April 1990

Date to be completed: April 1991

A copy of the protocol is attached.

6. Project Implementation:

The following projects could not be carried out yet largely due to lack of staff:

i. Nutritional status possibly aggravated by intestinal parasitism.

ii. Immunosuppressing related to Nutritional deficiencies

iii. Iron and other mineral deficiencies

7. Future Projects

With the return of additional staff from training overseas, the folowing remaining Projects have been planned for the years ie up to end of the present programme (agreement).

i. Nutritional status possibly aggravated by intestinal parasitism - in collaboration with Parasitology and haematology units.

ii. Iron and other mineral deficiencies

iii. Infants Nutrition

iv. Energy expenditure and mothers activity during income generating activities and the impact on the health and nutritional status of mothers and their children.

8. Publications

1. L.A. Brakohiapa; J. Yartey; A. Bille; E Harrison, E. Quansah; M.A, Armar; S. Yamamoto, K. Kishi (1988). Does Prolonged Breastfeeding Adversely Affect A child's Nutritional status? The Lancet. August, 1988, pp.410-418

In preparation

2. E.E.K. Takyi; T. Rikimaru; E.Addo, E. Harrison; D.O. Kennedy, E. Quansah - Vitamin A status in a rural community in Ghana.

3. E.E.K. Takyi; T. Rikimaru; Y. Kido; D.O. Kennedy - Development of Rats fed on weanimix and Alfamix diets.

9. Seminar

Under the sponsorship of JICA, the Unit is seriously arranging to hold a one-day seminar on "WEANING PRACTICES IN GHANA". Forty (40) delegates/participants from Ministry of health, University of Ghana, UNICEF, WHO, USAID and some hospitals are being invited to share ideas on this topic with the view of finding a (more) lasting solution to the problem of weaning in Ghana.

The seminar has been fixed for 26th September 1990 at the Noguchi Memorial Institute For Medical Research, Legon.

Dr. E.E.K. Takyi
Head of Unit

APPENDIX

NUTRITION UNIT

TITLE:	REJECTION OF WEANING FOODS BY BREASTFED CHILDREN IN TWO RURAL GHANAIAN VILLAGES (ASHALLEY BOTWE) AND GOMOA FETTEH
PRINCIPAL INVESTIGATOR:	L.A. BRAKOHIAPA
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REPORTED BY:	L.A. BRAKOHIAPA

REJECTION OF WEANING FOODS BY BREASTFED CHILDREN IN TWO RURAL GHANAIAN VILLAGES (ASHALLEY-BOTWE AND GOMOA FETTEH

Many years after naming the nutritional syndrome "Kwashiorkor" in a clinic in Accra, malnutrition in the underfives was reported by UNICEF to be 53% in 1983 and fell to 33-40% in 1986 in the 7-42 month old children in this country. Inspite of the slight improvement in 1986, the figures quoted above are quite high. There are many factors which can affect the nutritional status of pre-school children. Some are of socio-economic origin. Health, Sanitation and cultural beliefs and weaning practises could also affect a child's growth.

The commonest belief as to the aetiology of malnutrition in third world countries is inadequacy of protein and calorie intakes. This inadequacy has been attributed to the bulkiness of weaning foods and co. lementary foods, and also to unavailability of high quality proteins. Measures to combact malnutrition at both international and national levels have therefore been geared towards improving protein and energy intakes of pre-schoolers with multimixes and cereal legume mixtures (Cameron et al) (Scrimshaw). However, Woolfe et al and Brakohiapa et al reported adequate caloric and protein intakes of Ghanaian children with normal appetite. Armar also reported adequate growth of breastfed children on supplementation with Ghanaian weaning foods to be comparable to that of the NCHS reference standard.

These findings may therefore be indicators that some other factors might also be contributing towards the incidence of malnutrition in this country. That is to say, that inadequate food intake might not necessarily be the result of unavailability of food at all times.

During the above mentioned studies by Brakohiapa et al (1988) and Armar (1989), we observed that, some children rejected supplements and complements. The rejections became worse in the older age groups. Unlike in Mali where Dettweyler (1986) reported that supplementation started rather late, we observed that in the two communities mothers started supplementing breastmilk with koko latest by the fourth month. However some children started rejecting the supplements a month or two after it was introduced. These early rejections if not intervened on time, could lead to total rejection which in turn could result in malnutrition. As Underwood (1985) rightly stated, Weaning practises favouring prolonged breastfeeding, together with food limited in variety could have adverse repercussions later on in a child.

AIM

The aim of this study is to find out which other factors other than the already accepted one, that could adversely affect growth of breastfed children.

OBJECTIVES:

1. To investigate whether there is any correlation between the time of introduction of weaning foods to a child and the time that

supplement is rejected.

2. To find out if the type of supplement given has any effect on its acceptance by breastfed children.

3. To monitor growth of babies, to find out if the ordinary Ghanaian foods are able to sustain growth adequately in normal children.

METHODOLOGY:

Work started at the end of April 1988 and was suspended in May, 1989 Open ended questionnairs were used and a thropometric measurements carried out to select healthy breastfed babies who had not started supplementation (originally 74 children were recruited in the 2 villages but only 48 remained by the end of the first year), aged between 1 week and 3 months. Other breastfed children who were more than 3 months old were also selected for longtudinal growth monitoring. Selection of subjects were strictly based on the age range mentioned above and mothers' willingness to participate in this work (inspite of the latter some mothers especially in the follow up growth monitoring group opted out a few weeks after commencement of the work.

Mothers were told why their children had been chosen, (see objectives). They were also told to inform us during our visits. when supplementation started, if this took place during our absence and with what supplement. They were allowed to continue with whatever supplementation child was on, if supplementation started during our absence, or choose which supplement they wanted to give to the child, if supplementation was about to begin.

These arrangements were to prevent upsetting mothers or babies.

ly supplements used in the communities were used.

four supplementary groups were formed ie:

1. koko group 2. koko + milk group 3. Weanimix group (Cereal: legume = 3:1) 4. The children in this group could be given any of the other three supplements as and when the mother chose to.

To avoid inability to purchase some of the items, each day's allocation of powdered milk (10g) sugar (20g) weanimix (60g) were neatly bagged in polythene bags for the duration of 2 weeks. Remnant were returned as proof of rejection.

Mothers were advised to breastfeed babies first and to supplement only when they were sure babies were still hungry. During the two weekly visits, mothers were interviewed as to acceptance or rejection of the food their babies were on. If the response was positive mothers could continue with the ration or opt for another group. On such a case this change would not be considered as a rejection. However, mothers for reasons unknown to us, inspite of encouragements to diversify supplements, stuck to one particular ration throughout or till the child rejected it. In case of rejections a mother then chose the group she wanted her baby to be put on.

Some children kept rejecting the various supplements, but their mothers were encouraged to have time and patience during the feeding of such children, a task which, we observed, many mothers found difficult to perform. (This is probably because of their work load since many of them were either farmers + petty traders or fishmonger + petty tradding or fishmonger + farmer, depending on the time of the year). Children whose mothers followed these instructions might end up taking some spoonfuls of supplements so that hopefully by the 6th - 8th months when complementary foods were introduced they might have learnt is accept them instead of rejecting them. If instructions were not followed such children could end up rejecting subsequent supplementary foods. As explained else where 48 breastfed children, both boys and girls, were used in this longitudinal study.

RESULTS:

Table 1 shows that between 12-4 months only 3 of 22 children in the 2 villages had been weaned. Another child was weaned at 3 months because the mother was sick. These findings confirm the findings in our first study that children in the community studied were breastfed for long periods.

Table two indicates that supplementation started quite early in the two communities, as early as 2 weeks in some instances 23% of babies were receiving supplements 3 weeks after birth.

The third and fourth months however, were when the majority of babies were put on supplementation. The main reason given by mothers for starting supplemtation early was insufficient breastmilk out put because of the frequent cryings of babies after suckling (Babies are breastfed on demand in both communities). This is contrary to the Malian practice where supplementation is reported to start rather late and where mothers do not associate supplementation with breastmilk output (Dettweyler, 1986)

Inspite of the campaign by health workers on prolonging or exclusively breastfeeding till 5th - 6th months in this country before introduction of semi solid and solid foods it seems as if the rural mothers still stick to their cultural beliefs ie what their mothers did, is what they will do and not necessarily what the health worker or the government tells them to do. Another reason for the early supplementation might be that of convenience to the mother. It is easier to leave a child behind with a cupful of koko than to carry her to the farm.

Underwood (1985) reported that rejection of food as reported by Thai mothers could be due to failure to stimulate early acceptance of varied eating pattern during weaning. This could apply to our rural children used in this work. Although they were introduced early to supplementary foods, they were kept on the same ration for a long time.

Could the monotony in the foods given have led to the rejections observed in this work? Unfortunately, since not many mothers opted for group 4 (Tab. 7), we can not draw any conclusions. Our subjects however had an unvaried supplementation over considerably long periods.

There seems to be no correlation between age of commencement of supplementation and time of its rejection (Tab 6. r= 0.0859). When rejections in the different supplementation groups during the first three months (prior to begin of complementary feeding) were compared using t test of proportions from independent groups, it showed that, the type of food given may not have influence on its acceptance (p= higher than 0.05) ie any of the weaning foods given in these communities could be rejected by the subjects irrespective of time of introduction.

Disturbingly enough one would have expected less subjects to reject supplements as they grew. The reverse was observed during this study. The third experimental month when most of the babies would have been between four and six months was when most of the subjects (23%) rejected the various supplements. The mean weight gains of all the subjects during the first three experimental months were all above the NCHS reference standard, using weight for length and 80% as the cut off point for well nourished children. This shows that when mothers encourage breastfed babies to eat supplementary foods, be it even a little at a time, but regularly, growth will be favourable. None of the subjects had a w +/L below 80% throughout except one subject (77%), who had his growth improved to 87% by the third month.

DISCUSSION:

Forty eight breastfed children in Gomoa Fetteh, a fishing village and Ashalley Botwe, a farming village, were recruited for this longitudinal study on acceptance or rejection of weaning foods by breastfed children. Results indicate that early supplementation with either koko, koko + milk or weanimix is practised in these communities. However although 54.2% of children accepted supplements readily, 45.8% partially rejected them at one time or the other during the first three experimental months when the age of the babies ranged between 2 weeks and 6 months and none of them was receiving any other solid foods. Underwood (1985) and Dettweyler (1986) reported similar observations made in Thailand and Mali . Underwood hypothesised that failure to stimulate early acceptance of varied eating pattern during weaning could lead to ancroxia, which in turn could also lead to growth faltering. Our subjects definately had unvaried eating patterns over considerable periods, since mothers were reluctant to prepare different supplements daily.

The same writer wrote that some Thai mothers complained that their babies (all over 6 months) had no appetite for weaning foods. This is

similar to our finding where the number of subjects who showed rejection increased with age (Tab 6 &7). Even with the different types of foods rejection did take place and increased in number as the children grew older. Why this should be so instead of older children accepting food readily, is a puzzle. There could be something in this hypothesis that monotony of supplementation could lead to aneroxia (Underwood, 1985). It is however evident, that if mothers overlook these early rejections for too long, children of mothers with insufficient breastmilk output may end up being malnourished.

As Tab. 8 shows, both the children who did not reject and those who rejected showed favourable growth compared with NCHS reference standard. This is an indication that although rejection may take place in some children, mothers must continue to supplement brestmilk pat ntly with a variety of supplements, to avoid faltering of growth which might subsequently result in malnutrition. If persistent rejection is not tackled early it could lead to exclusive brestfeeding. But as Underwood writes. "Exclusive breastfeeding beyond age 4 months or predominant breastfeeding beyond 9-12 months of age can mute the learniug experience provided from exposure to new tastes and textures of food. We must therefore educate mothers to introduce their babies to different supplements to enhance their learning experience" to new tastse and texture in order to forestall any total rejections which might lead to prolonged breastfeeding. The same researcher wrote that children sustained on a limited amount of variety ie monotonous foods might end up being the stunted or wasted preschool children of later years.

CO. USION:

There are indications that partial rejections do occur in young children introduced to supplementation. These rejections take place irrespective of time of introduction to supplementation or type of food given. We suspect that this could be due to the monotonous nature of supplementation.

Mothers should therefore be educated to supplement babies breastmilk with a variety of weening foods to avoid rejection. Lastly they should exercise patience when feeding babies especially those who do not want to eat. More work will have to be done, however, with a bigger sample size, before we can confirm the findings made in this study.

BUDGET

An amount of ¢157,867.22 has so far been spent on this project (1988 - 1989).

Table 1 Age distribution of breast fed and weaned children at the beginning of study in Gomoa Fetteh and Ashalley Botwe

	1 day 2.11 m.	3 m. 5.11	6 m. 8.11	9 m. 11.11	12 m. 11.11	15 m. 17.11	18m 20.11	21 m,
Gomoa Fetteh								
Breast fed (n)	54	32	7	8	11	4	1	-
" " (%)	44,6	26.5	5.8	6.6	9,1	3.3	0.8	
Weaned (n)	-	-	-	-	2	1	-	1
" (%)	-	-	-	-	1.7	0.8	-	0.8
Ashalley Botwe								
Breast fed (n)	13	14	7	2	2	-	-	-
" " (%)	33.3	35.9	18.0	5.1	5.1	-	-	-
Weaned (%)	-	1	-	-	-	-	-	-
" (%)	-	2.6	-	-	-	-	-	-
Combined								
Breast fed (n)	67	46	14	10	13	4	1	-
" " (%)	41.9	28.7	8.7	6.2	8,1	2.5	0.6	-
Weaned (n)	-	1	-	-	2	1	-	1
" (%)	-	0.6	-	-	1.3	0.6	-	0.6

Table 2. The different ages in months at which supplementation started in Gomoa Fetteh and Ashalley Botwe

		Total No.	Under 2wks	2-3 wks	1 m.	2 m.	3 m.	4 m	5 m.	6 m& Above
Gomoa Fetteh	(n)	53	5	6	5	3	6	12	6	10
" "	(%)	100.0	9.4	11.3	9.4	5.7	11.3	22.6	11.3	18.9
Ashalley Botwe	(n)	25	4	3	3	1	9	4	-	1
" "	(%)	100.0	16.0	12.0	12.0	4.0	36.0	16.0	-	4.0
Combined	(n)	78	9	9	8	4	15	16	6	11
	(%)	100.0	11.5	11.5	10.3	5.1	19.2	20.5	7.7	14.1

No. of children introduced to supplementation before the age of 3 months.

Gomoa Fetteh	19	(35%)
Ashalley Botwe	11	(44%)
Combined	30	(39%)

Table 3 Initial supplementary foods used

	Gomoa Fetteh	Ashalley Botwe	Combined
Koko	83(56.8%)	60(87.0%)	143(66.5%)
Fortified Koko with milk groundnuts or fish powder	33(22.6%)	3(4.3%)	36(16.7%)
Both Koko + Weanimix	5 (3.4%)	1(1.5%)	6(2.8%)
Weanimix	2 (1.4%)	2(2.9%)	4(1.9%)
Others (Formula, Cereal, Tom-brown, Rice water, Tea & bread)	7 (4.8%)	3(4.3%)	10(4.7%)
No supplementation till intro-duction of adult foods	7 (4.8%)	-	7(3.2%)
Don't know (Mothers with 1st babies)	9 (6.2%)	-	9(4.2%)
Total	146(100.0%)	69(100.0%)	215(100.0%)

Table 4 Infant feeding as influenced or not influenced by taboos in the 2 villages before baby is 6-8 months old (Number of mothers interviewed)

	Gomoa Fetteh	Ashalley Botwe
Taboos	60 (36.6%)	19 (33.9%)
No taboos	102 (62.2%)	31 (55.4%)
Don't know	2 (1.2%)	6 (10.7%)

Table 5 Reasons given by some mothers for not giving certain foods to their babies who are not more than 6 m. old

Name of food	Gomoa Fetteh	Ashalley Botwe	Reason
Weanimix	1	-	Diarrhoea
Eggs	1	-	When given too early child may not walk.
Formula	1	-	Constipation
Kokonte	2	2	Diarrhoea
Ampesi	4	-	Heavy to digest
Gari	2	2	Heavy upsets child's tommy
Kuntomire	2	-	Vomitting
Kenkey	-	1	Heavy
Rice	-	1	Vomitting
Milk	-	1	Vomitting
Fruits esp. Mangoes	2	-	Diarrhoea
Fufu	44	12	Too starchy and heavy. Fed with this, child may not walk early.

Table 6

AGE OF COMMENCEMENT IN MONTHS	TOTAL NO.	REJECTIONS DURING THE FIRST 3 STUDY MONTH				
		1	1	2	3	TOTAL
1	2	-	-	-	2	2
1	11	-	1	2	1	4
2	15	-	2	2	3	7
3	11	-	1	1	4	6
4	6	-	1	-	-	1
5	3	-	1	-	1	2
Total	48	0	6	5	11	22

Table 7

TYPE OF SUPPLEMENT	TOTAL NO.	REJECTIONS DURING THE FIRST 3 STUDY MONTH			
		1	2	3	Total
Koko	12	4	1	1	6
Koko + Milk	23	1	4	5	10
Weanimix	8	1	-	3	4
Group 4	5	-	-	2	2
Total	48	6	5	11	22

Table 8 : Mean weight/length of subjects aged between 2 weeks and 6 months during the three experimental months.

	$\bar{x}$ 1 w/l	$\bar{x}$ 2 w/l	$\bar{x}$ 3 w/l
Rejections (n=22)	103.3 + 11.9	104.7 + 8.2	102.6 + 9.3
No Rejections (26)	107.0 + 11.3	103.2 $\pm$11.6	103.8 $\pm$10.6
Total (48)	105.5 + 11.6	104.1 $\pm$ 9.7	103.3 $\pm$10.0

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APPENDIX

Title: POSSIBLE INCORPORATION OF ALFALFA INTO SUPPLEMENTARY FOODS OF CHILDREN

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INTRODUCTION

It is the aim of the Nutrition Unit to evolve one of the most economical and efficient supplementary diet which could be introduced into infant feeding so as to improve their nutritional status. We have therefore decided to research into the use of Alfalfa as a supplement in infant feeding.

Alfalfa is a leguminous plant, much like peas and beans; however, the leaves and sprouts are eaten rather than the seeds alone (1). It is one of the richest land-grown sources of nutritional trace minerals. Its deep feeder roots go down into the soil fifty feet or more to bring out the much needed trace minerals.

It is also one of the best sources of iron, magnesium, phosphorus, sulphur, sodium, potassium, calcium chlorine, silicon and vitamin K (2).

Alfalfa is a splendid 'milk producer' in nursing mothers and an excellent substitute for milk in children with lactose intolerance (2).

It is easy to grow and can thrive on any type of soil. Both the leaves and sprouts contain high levels of B-corotene and protein - eg edible protein yields from Alfalfa, in Britain, was 1100kg/ha/year, as compared to a figure of 100 - 200kg/ha/year and 840kg/ha/year, respectively, for intensely reared cattle and field beans (3). Anaemia, night blindness and Kwashiorkor are thus conditions which can be improved by daily consumption of Alfalfa as leaf nutrient or nutrient cake (3).

Infact, work in our unit on the comparative analysis of Alfalfa and commly-used leaf vegetables has confirmed that Alfalfa is superior to the others (table 1) so far as protein, B-carotene and sugar levels are concerned and comparable so far as the elemental composition is concerned.

2. PLAN OF PROJECT

Phase 1: Animal feeding test.
Aim: To compare the response (growth, haematology and general behaviour) of rats fed on diet containing Alfalfa with those fed a popular weaning food.

Phase 2: Child feeding: Studies in phase 1 would be repeated using children, 1 - 5 years old, in a centre.

3. EXPERIMENTAL

PHASE 1: ANIMAL FEEDING TEST

3.1. MATERIAL

Alfalfa: Fresh Alfalfa leaves, with moisture content of 80 % were purchased from a farmer, and stored in a deep freezer. This was used in the preparation of nutrient cakes.

3.2. PREPARATION OF ALFALFA NUTRIENT CAKES

Fresh Alfalfa leaves (40 g) were homogenized with water (300ml) in a homogenizer, for 3 min. using the highest speed. The homogenate was sieved and the filtrate heated quickly to 90°C over a gas burner. The precipitate was collected by fitering through a cheese cloth, dried at 80°C for 5h. The cake was storred in a deep freezer and used in feed composition.

3.3 PREPARATION OF FEED

3.3.1 Roasting of corn: Dry corn (moisture content, 10%) were roasted in an oven at 180°C for 3hr, with occasional stirring.

3.3.2. Preparation of Alfalfa feed (Alfamix)

Roasted corn and Alfalfa nutrient cake were weighed out and mixed in

feed was prepared every week.

3.3.3. Preparation of weaning diet (Weanimix)

Groundnuts (moisture content, 12%) were roasted in an oven (180°C for 3hr) and mixed with roasted corn (1:4 w/w). The mixture was ground in a corn mill and pelletized, and used for animal feeding. As before, the prepared feed was stored in a deep freezer; new batch was prepared every week.

3.4 ANIMAL FEEDING

Thirty-six (36) rats (Wistar, 18 males, 18 females, 3 weeks old) from the Institute's Animal House, were used.

They were divided into 3 groups and fed the following diets for 4 weeks:

(i) A group (6 males, 6 females) fed on normal rat diet - stock diet group.

(ii) A group (6 males, 6 females) fed on Alfamix.

(iii) A group (6 males, 6 females) fed on weanimix. Each rat was kept in a separate cage. During the feeding period, the following indices were monitored daily:

(i) Food consumption,

(ii) Water intake,

(iii) General behaviour, including morbidity and mortality. Body weight and tail length were monitored every three days.

At the end of the feeding period, the following analyses were done:

(i) Blood picture: The tail of each rat was cleaned with cotton wool soaked in warm water. Each tail was cut off about 1.5" from the tip with a pair of scissors. The blood collected was used for the following analyses: Haemoglobin, haematocrit value, RBC and WBC (total and differential).

(ii) Biochemical parameters: Blood was withdrawn from each rat via the Antenior Vena Cava into test tubes, allowed to clot and the serum collected after centrifugation at 3500 r.p.m. for 10 min.

The sera was kept frozen in a deep freezer and used for the following analyses: RBP, Pre-albumin (by radial immunodiffusion) Vitamin A (by HPLC) protein (biuret) creatinine, urea nitrogen and total cholesterol (4).

(iii) Weight of Vital Organs: Each animal was cut open and the following organs dissected out, clotted and weighed: liver, kidney, brain, lungs, heart, sinus, spleen, adrenal gland, small intestine, large intestine, stomach, fallopian tube, ovaries, testis and thigh muscles.

(iv) Histology: Each of the above organ was fixed in 10% formalin for histological examination, using routine methods:

3.5 CHEMICAL ANALYSIS

Samples of feed from the different batches of feed were analysed for their composition, using routine methods, thus: protein, (kjedahl) fats, carbohydrates. B-carotene (HPLC) and energy (bomb calorimeter).

RESULTS

4.1. Comparative analysis of Alfalfa, kontomire, borkorborkor, wild lettuce, and cabbage.

Table 1 shows the results of chemical analysis of Alfalfa and the leafy vegetables. Results indicate that:

(a) Protein: Alfalfa contained the highest protein level of all the leaves [illegible] the lowest (of 3.4) found

(9g% vrs. 7.4g%).

(b) Energy, Fat, total sugar CHO: Alfalfa had highest levels of all these indicators in all the leaves analysed.

(c) Elements: On the whole, the elemental composition of Alfalfa is comparable to the levels in the other leaves analysed.

(d) B-carotene: Alfalfa contained the highest level in all the leaves analysed. Here too, the level of 28144mg is more than the sum of the levels found in the other leaves (i.e. 28144mg/100g vrs. 24825 mg/100g).

4.2. FEED ANALYSIS

Table 2 shows the results obtained from the chemical analyses of the three diets tested. It can be seen that there were significant differences among the three feeds with respect to Fat, protein, carbohydrates, B-carotene and energy levels and all these differences invariably contributed to the ability of each feed to (a) be accepted for consumption, and / or (b) support growth and development of the respective rats.

4.3 FOOD AND WATER INTAKE

Results in table 3 shows that male rats fed on stock, Alfamix and eanimix diets consumed 1841.6g, 1898.9g and 1475.6g of the respectively feed in 4 weeks as against corresponding values of 1832.3g, 1977.9g and 1590.4g for female rats. This shows that rats fed on weanimix diet consumed less feed than the others; consequently, the total feed consumed by the 12 rats in each group were 3673.9g (stock diet), 3876.8g (Alfamix) and 3066.0g (Weanimix). During the 4 weeks feeding period, a total volume of 4897.3 ml (stock diet), 3861.6 ml (Alfamix) and 3119.0 (Weanimix) were consumed. of water

4.4 General Behaviour During Feeding Period

The rats showed no sign of morbidity during the 4 week feeding period; there were no death either.

4.5 Changes in body weight

The mean values for the rats fed on the 3 diets are shown in table 4 and represented graphically in figs 1, 2, 3, 4 and 5.

As seen in Fig 1, male rats fed on stock diet gained the highest weight followed by meals fed on Alfalfa. Significantly less weight were gained by rats fed on weanimix.

The picture is a bit different in fig. 2 which shows that female rats fed on Alfamix gained marginally more weight at the end of the feeding period, than those fed on stock diet. In this case too, female rats fed on weanimix gained significantly less weight.

Fig 3 shows the changes in both sexes of all the 3 diets, while figs 4 & 5 are logarithmic representation of the changes in male and female rats, respectively.

4.6 Organ weights

The mean values of the absolute weights and relative weights are respectively depicted in tables 5 & 6.

From table 6, it can be seen that there is no difference in the organ/body ratios for the liver, spleen, sinus, thigh muscle, and tests while there were marginally higher ratios in the case of weanimix group for the heart, kidney, lungs, stomach, small intestin and the fallopian tube. The most striking difference was a ratio of .030 for the Brains of rats fed on weanimix, as compared with a ratios of .016 and .017 respectively, for rats fed on stock diet and Alfamix.

4.7 Blood Picture

It can be seen that there are no significant differences among these values in any of the rats fed on the different diets.

4.8 FOOD EFFICIENCY

Food efficiency gives idea about the efficiency of conversion of food into body weight.

Results shown in table 8 indicate that in the case of stock diet, and Alfamix, the male rats converted more feed into body weights than female; the situation is however reversed in rats fed on weaning diet.

Furthermore, rats fed on stock diet converted more feed into body weight than those fed on Alfamix or weanimix; consequently, the mean food efficiency values for stock diet, Alfamix and weanimix were 0.216, 0.189 and 0.093, respectively.

5. DISCUSSIONS

The present study was designed to compare the effectiveness (or ability) of Alfalfa cake, (formulated as Alfamix) as a whole to promote growth, and general well being of rats with normal rat diet and weanimix, a popular diet used in weaning children in Ghana.

Results so far obtained indicate that:

(i) Rats consumed more Alfamix (3879g) and stock diet (3674g) than weanimix (3066g) and this partly explains the higher gain in body weight of rats fed on stock diet and Alfamix, as compared to those fed on weanimix. In addition, the food efficiency ratios (table 8) shows mean values of 0.216, 0.189 and 0.093, respectively, for rats fed on stock diet, Alfamix and weanimix suggesting that more of the first two diets were used up in body building than the weanimix diet.

These ratios also indicate that even if the same amounts of the 3 diets were consumed, weight gained by rats fed on Alfamix would be more than those fed on weanimix but lower than those fed on stock diet.

(ii) Even though the rats fed on the 3 diets consumed different amounts of feed, results so far obtained from haematological investigations shown no significant difference among the various indicators monitored (table 7).

6. CONCLUSION

From the results available, it can be concluded that Alfamix supports growth (as measured by gain in body weight), in rats, better than weanimix, a popular weaning food in Ghana.

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TABLE 1. NUTRIENT COMPOSITION

Leaves	Value per 100g fresh sample											
	Moisture (g)	Energy (kcal)	Protein (g)	Fat (g)	CHO (g)	Ca (mg)	Fe (mg)	Na (mg)	K (mg)	T.Sugar (mg)	β-carotene (μg)	Total Ash (g)
Alfalfa	79.5	82	6.9	0.13	12.2	16.6	0.34	1.20	136.3	0.90	28144	1.3
Cabbage	93.7	17	1.2	0.05	4.7	10.3	0.21	3.00	152.3	0.42	15	0.5
Kantomire	88.6	46	3.0	0.10	7.6	15.1	0.30	1.32	143.8	0.70	2528	0.7
Lettuce	92.2	-	-	-	-	13.3	0.31	2.50	167.5	-	-	-
Borkorborkor	92.9	21	0.6	0.1	6.0	19.7	0.44	4.52	457.5	-	4760	0.4
Wild Lettuce	89.1	38	2.6	0.11	7.5	25.2	0.24	3.00	265.0	0.34	17522	0.7

Values shown are means of quinplicate determinations of 5 samples each. CHO = Carbohydrate.

Table 2 FEED ANALYSES

FEED	Moisture (g/100g)	Fat (g/100g)	Protein (g/100g)	Carbohydrate (g/100g)	B-carotene (µg/100g)	Energy (Kcal/100g)
Stock diet	7.0	2.8	11.2	ND	6.22	360.8
Alfamix	10.6	6.3	13.1	ND	1443.54	411.5
Weanimix	9.6	9.7	9.9	ND	67.65	439.7

Alfamix = roasted corn: alfalfa cake (4:1 w/w); weanimix = roasted corn: roasted groundnuts (4:1 w/w). Each batch of feed was analysed 5 times and the mean value determined: ND = Not yet done.

Table 3. FOOD AND WATER INTAKES

Diet / Rat	Food intake (g)		Water intake (ml)	
Stock diet				
Male (n = 6)	1841.6	11.4	2420.2	15.5
Female (n = 6)	1832.3	11.3	2477.1	15.9
	(3673.9)		(4897.3)	
Alfamix				
Male (n = 6)	1898.9	11.7	1785.8	11.5
Female (n = 6)	1977.9	12.2	2075.8	13.3
	(3876.8)		(3861.6)	
Weanimix				
Male (n = 6)	1475.6	9.1	1537.0	9.9
Female (n = 6)	1590.4	9.8	1582.0	10.2
	(3066.0)		(3119.0)	

Σx = total food / water consumed in 4 weeks; $\bar{X}$ = mean food / water consumed per day.

Table 4. CHANGES IN BODY WEIGHT

Group / Rat	Weight on day								
	3	6	9	12	15	18	21	24	27
Stock diet									
Male	24	63.5	104.0	148.C	209.0	266.5	320.0	369.5	425.0
Female	35	69.5	115.5	151.0	199.5	247.0	296.0	323.0	368.0
Alfamix									
Male	21	61.5	99.5	142.5	181.0	221.5	274.5	313	366.5
Female	33.5	74.5	121.5	170.0	218.5	263.5	302.4	352	366.5
Weanimix									
Male	9.5	20.0	33.5	48.5	69.5	86.0	101.0	115	132.5
Female	11.5	30.0	47.0	60.0	82.0	100.0	120.5	130.5	150.5

Values shown are total weight gained by all the 6 rats in each sex, on the days indicated.

Table 5 MEAN ORGAN WEIGHT (g)

Group	Liver	Heart	Kidney	Lung	Spleen	Brain	Adrenal gland	Sinus	Thigh muscle
Stock diet	4.12	0.38	0.79	0.58	0.35	1.52	0.10	0.34	1.13
Alfamix	3.82	0.39	0.72	0.51	0.32	1.47	0.11	0.33	1.03
Weanimix	2.16	0.31	0.50	0.37	0.19	1.40	0.08	0.15	0.55

Group	Testis	Stomach	Small intestine	Large intestine	Fallopin tube x ovaries
Stock diet	0.80	0.81	4.10	1.36	0.23
Alfamix	0.82	0.73	3.98	1.22	0.34
Weanimix	0.45	0.47	2.77	0.81	0.24

Table 6. MEAN RATIO OF ORGAN WEIGHT / BODY WEIGHT ($X10^2$)

Group	Liver	Heart	Kidney	Lung	Spleen	Brain	Adrenal gland	Sinus	Thig muscle
Stock diet	4.36	0.41	0.83	0.60	0.37	1.63	0.10	0.36	1.18
Alfamix	4.39	0.45	0.83	0.59	0.37	1.71	0.12	0.38	1.20
Weanimix	4.33	0.62	1.01	0.75	0.38	3.16	0.17	0.32	1.09

Group	Testis	Stomach	Small intestine	Large intestine	Fallopian tube x ovaries
Stock diet	0.81	0.84	4.37	1.45	0.24
Alfamix	0.98	0.85	4.58	1.42	0.38
Weanimix	1.00	0.96	5.63	1.61	0.47

Table 7 BLOOD PICTURE

Group / Diet	Mean values			
	Hb (g/dl)	Haematocrit value	Total RBC ($x10^{12}/L$)	Total WBC
Stock diet	13.35	0.47	7.27	10.38
Alfamix	13.03	0.47	6.98	9.93
Weanimix	12.48	0.48	7.22	8.68

Table 8. FOOD EFFICIENCY

Group / Rat	Weight gained (g)	Food consumed (g)	FE
Stock diet			
Male	425	1841.6	0.231
Female	368	1832.3	0.201
			(0.216)
Alfamix			
Male	366.5	1898.9	0.193
Female	366.5	1977.9	0.185
			(0.189)
Weanimix			
Male	132.5	1475.6	0.090
Female	150.5	1590.4	0.095
			(0.093)

FE = Food efficiency = weight gained (g) / Food consumed (g). Mean values for each group are shown in bracket.

Fig. I WEIGHT GAIN IN MALE RATS FED ON DIFFERENT DIETS

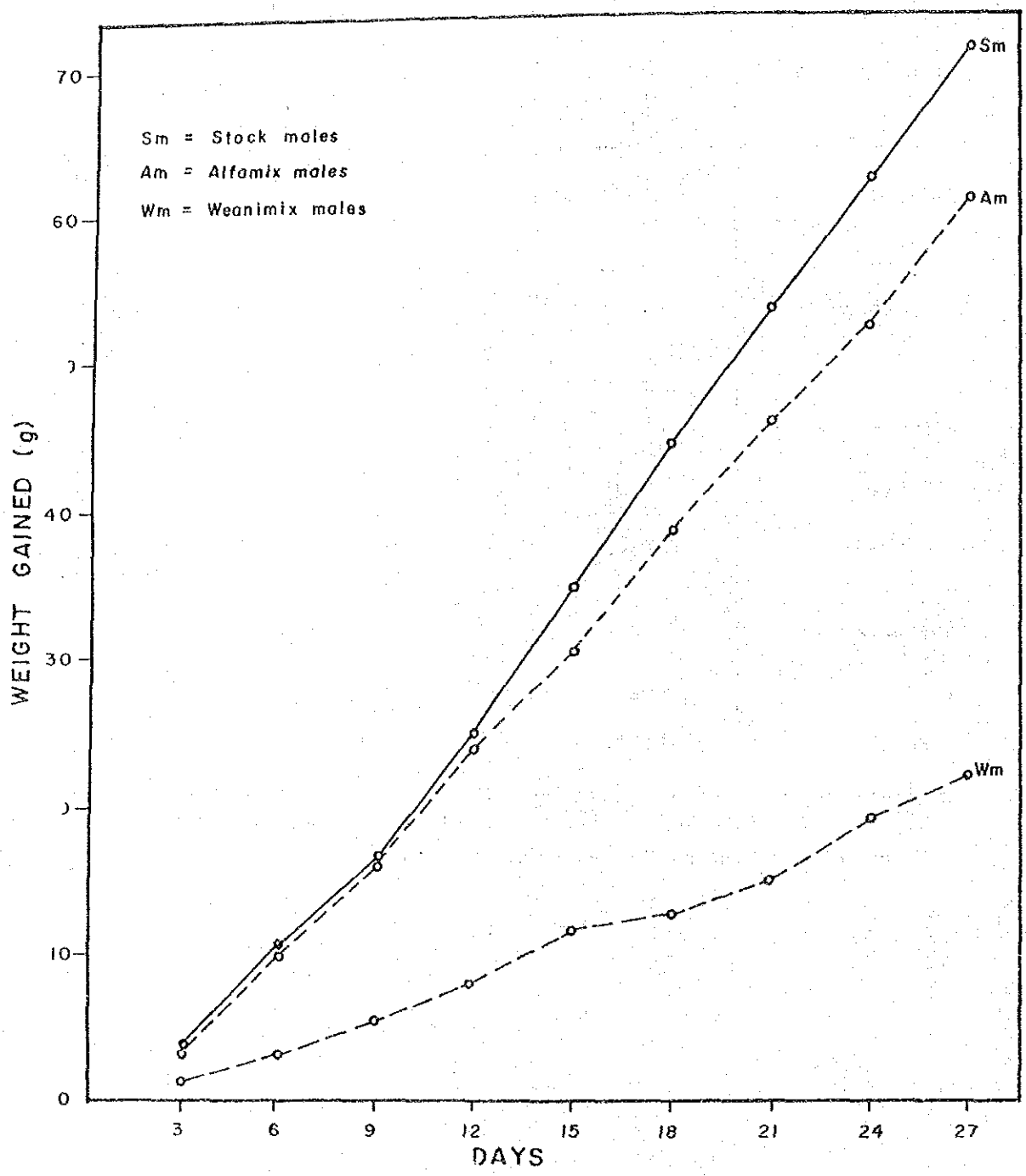


Fig. 2 WEIGHT GAIN IN FEMALE RATS FED ON DIFFERENT DIETS

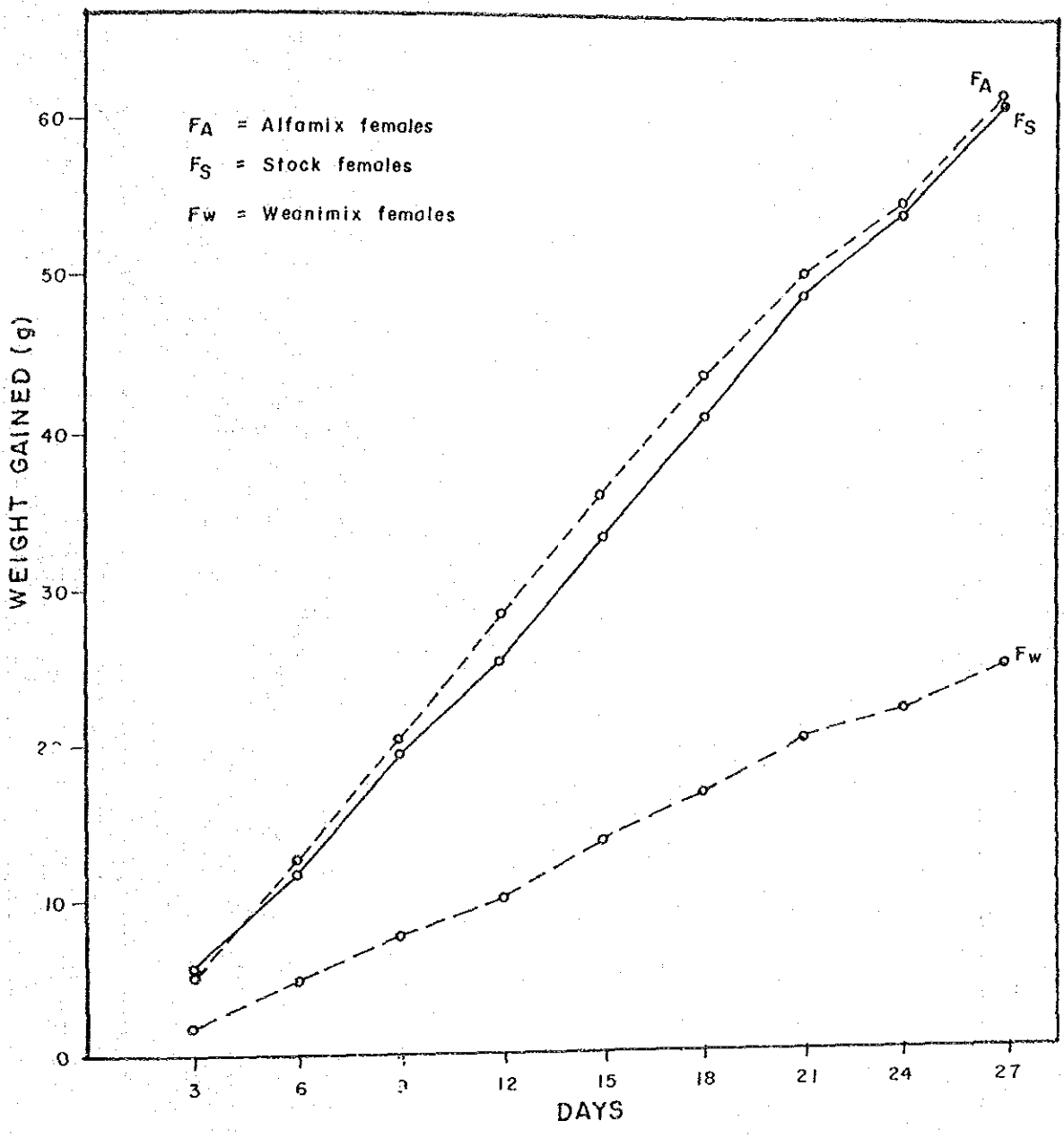


Fig. 3 WEIGHT GAIN IN MALE AND FEMALE RATS FED ON 3 DIFFERENT DIETS

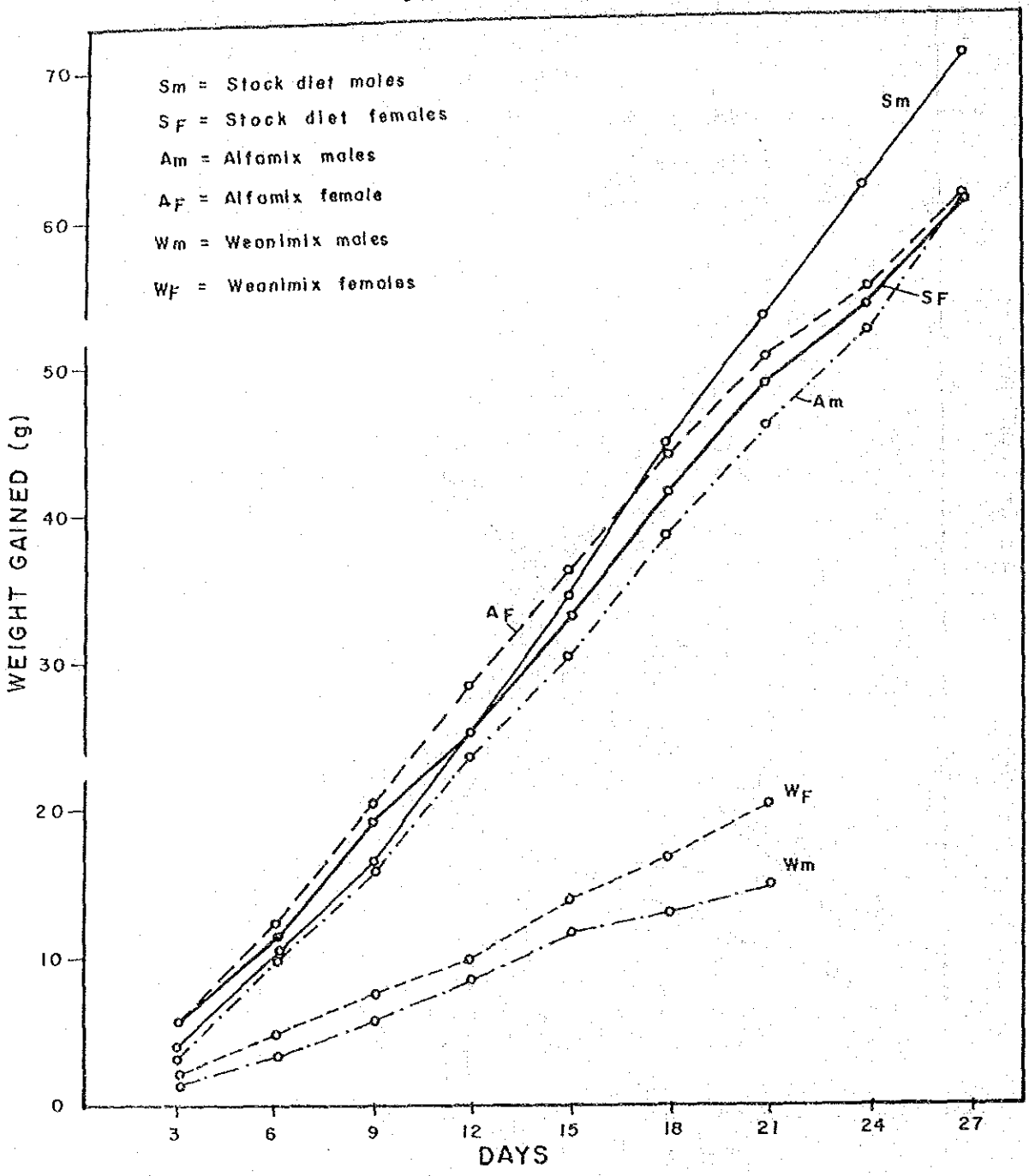


Fig. 4 LOGARITHMIC CHANGES IN BODY WEIGHT OF MALE RATS FED ON DIFFERENT DIETS

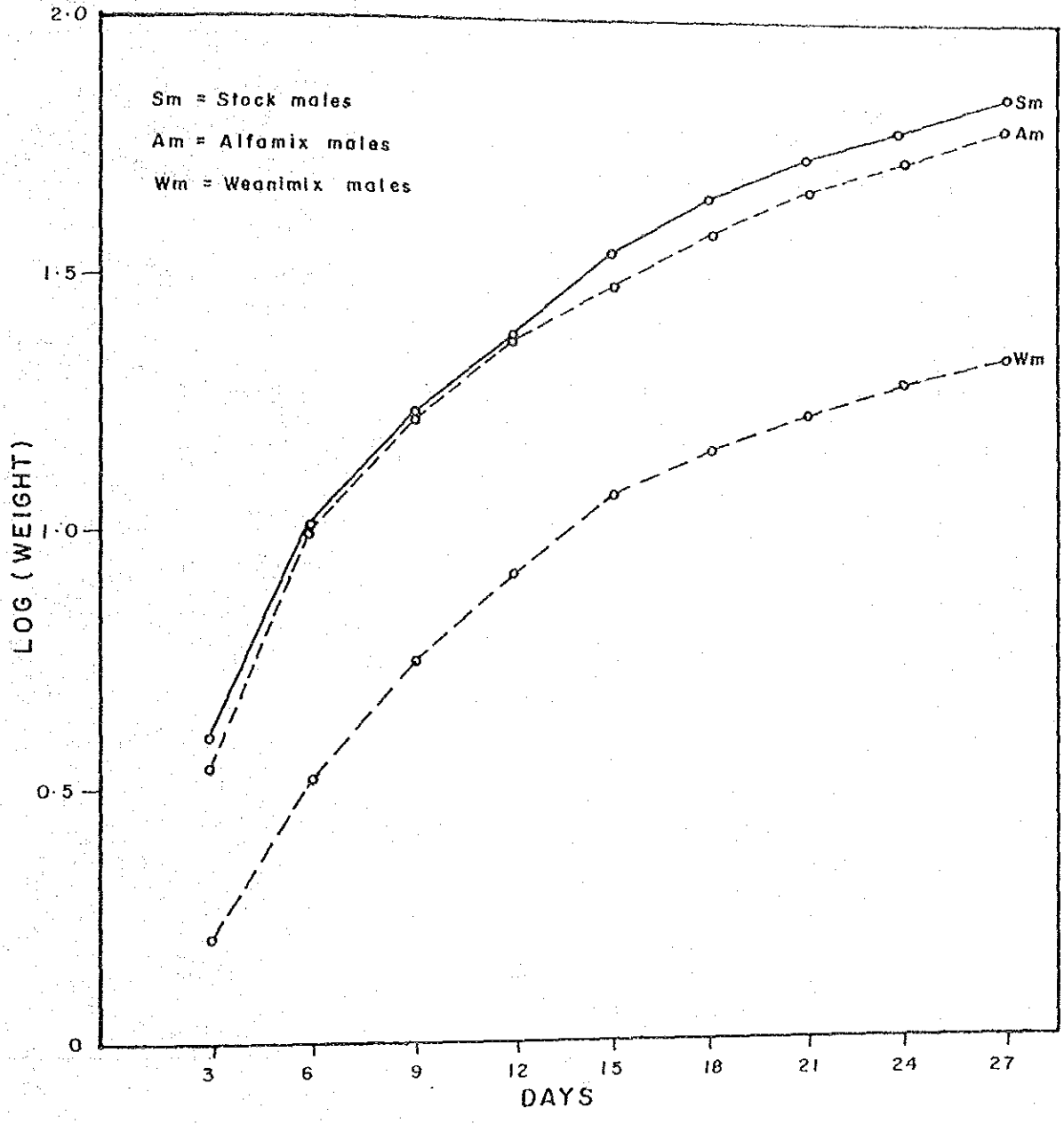
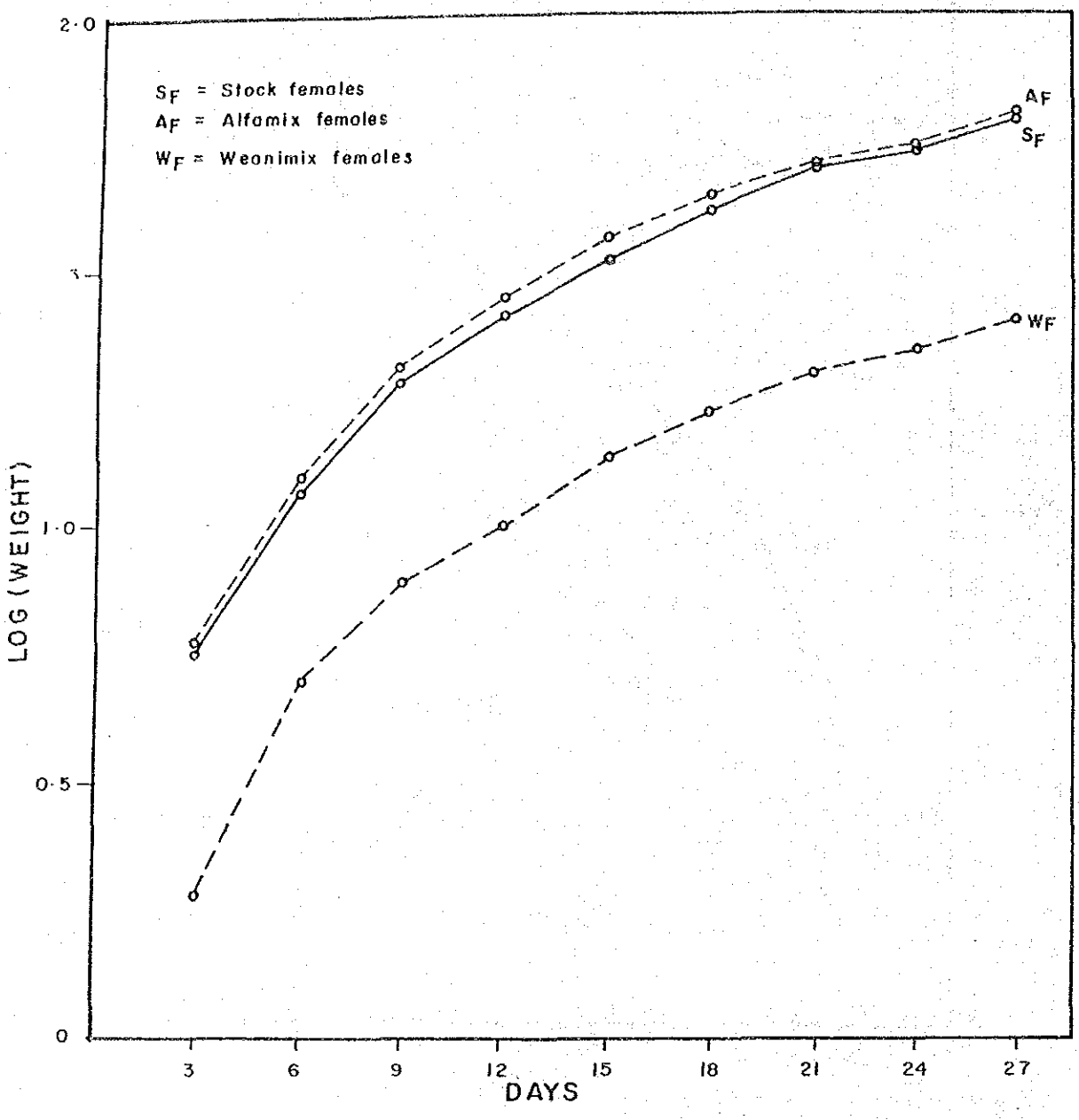


Fig.5 LOGARITHMIC CHANGES IN BODY WEIGHT OF FEMALE RATS FED ON DIFFERENT DIETS



TITLE STUDIES ON VITAMIN A

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Date Commenced:	March, 1990
Date to be completed:	September, 1990

1. INTRODUCTION:

Vitamin A is one of the few Vitamins of which both deficiency and excess cause serious health problems (1). Vitamin A deficiency is a nutritional disorder, caused by inadequate dietary intake of the vitamin or its plant-based precursors and often aggravated by low absorption from the intestine.

Vitamin A deficiency leads to xerophthalmia (a term used for all manifestation of vitamin A deficiency in the eye as well as a number of diseased conditions, such as growth failures, impaired immune response with lowered resistance to infection, sterility, nervous breakdown and finally death (1).

Vitamin A toxicity usually occurs as a result of abuse in vitamin A supplementation and therapy.

Since malnutrition is reported to be high in Ghana (2), our Unit has embarked upon vitamin A study to determine the extent to which vitamin A deficiency contribute to the overall malnutrition in Ghana.

2. OBJECTIVES

1. To determine the nutritional status of the Community through (a) dietary intake survey and (b) analysis of staple food.

2. To determine serum vitamin A, pre-albumin and Retinol Binding Protein (RBP) levels in the community.

3. To determine serum trighyceride, protein, glucose as indicators of the overall health status of the community.

4. To analyse selected foodstuffs for B-carotene levels.

3. EXPERIMENTAL

3.1. Dietary Survey

25 families in Gomoa Onyadze were randomly selected for the survey.

Daily dietary intake for 3 continuous days of all members of the selected families, excluding breast-fed babies, were recorded by investigators living close-bye.

Weights of all ingredients, including water used for meal preparation, together with the weight of the prepared meals were recorded using kitchen scales.

Dietary intake of each person was measured, as the difference between the initial and final weight of all meals taken, i.e. before and after food consumption.

Daily intake of each ingredient was calculated from the ratio in the cooked food. Food composition tables (3,4, 5) were used to calculate energy and nutrient intakes.

3.2. Blood Analyses

5ml of fasting blood were withdrawn from 263 inhabitants, ranging in age from 3 to 60 years. The blood was allowed to clot and Serum Separated by centrifugation at 3500 rpm for 10m. The sera were kept frozen in a deep freezer until used for the following analysis:-

(i) Vitamin A - by HPLC.
(ii) RBP and prealbumin - by Radial immunodiffusion.
(iii) Serum profile - glucse, protein and trighycerides, using routine analytical methods.

3.3. Analyses of B-carotene levels in Food items

The B-carotene levels of local food items were analysed using HPLC

.../2.

4. RESULTS

4.1. Serum Vitamin A Analyses:

The results from Serum analysis for vitamin A levels are shown in table 1.

Results indicate that:

(i) In the 3 - 5 year old age group (n = 47), 4.2% had vitamin A levels of less than 10ug/dl, representing a group deficient in vitamin A. 14.9% had levels of 10 - 20 ug/dl - low level group; 80.9% had adequate levels of 20 - 50 ug/dl.

The normal recommended level is 20 - 50ug/dl of serum.

(ii) In the 6 - 14 year olds, (n = 97), none had level below 10 ug/dl; 16.5% had low level; 82.5% had adequate level and 1% had high level i.e. higher than 50ug/dl.

(iii) In the 15 - 45 year old (n = 101) non had deficient level; 6.9% had low level; 86.1% had adequate level and 6.9% had high levels. The mean value for the 'high level' group was 56.9ug/dl.

(iv) In the older age group, i.e. those above 45 years, none had deficient level; 5.5% belong to the low level group, while 83.3% and 11.1% respectively, of the subjects belong to the adequate and high level groups.

Table 2 shows the serum profile of subjects of different vitamin A status.

As indicated, both RBP and prealbumin levels increased with higher vitamin A status. A rather high level, of prealbumin was found in the 'high level' vitamin A group.

The other indicators monitored did not shown any particular pattern; however all the values obtained are within the recommended range.

4.2. B- carotene Analysis

Results so far obtained are shown in table 3.

(i) Palm oil from 2 (two) markets in Accra had levels of 69000 - 95000ug/100g.

(ii) Coconut oil had levels of 8 - 53ug/100g.

(iii) Palm kernel oil had levels of 10 - 100ug/g.

Leafy Vegetables

(i) Fresh wild lettuce had levels of 17000ug/100g, while boiled ones had mean level of 1700ug/100g.

(ii) Fresh Kontomire had mean levels of 5200ug/100g while boiled ones had a mean level of 600ug/100g.

(iii) Dry leafy vegetables from the Northern part of Ghana had levels ranging from 302 - 7000ug/100g.

4.3 Nutrient Intake

The nutrient intake (for 2 age groups) for normal subjects (those with serum vitamin A level of 20 - 50ug/dl) and abnormal (those with level below 20ug/dl) are shown in tables 4 - 8.

(i) Energy intake: In the 2 groups, energy intake was above 60% RDA.

(ii) Protein: Intake in each case was above 70%.

(iii) Calcium intake: This was low, being below 50% RDA in 4 - 6 year olds of subnormal group.

.../3

(iv) Iron intake: In each group, intake was above 100% of RDA.

(v) Vitamin intake: Vitamin B_1 B_2 and intakes were very low while intakes of vitamins A and C were above 100% RDA; in the case of vitamin A, values were 300 - 500% RDA. Of a special significance is the observation that vitamin A intake in the abnormal group was higher than in the normal subjects.

5. DISCUSSION

The present study was designed to assess the vitamin A status in rural Gomoa Onyadze to determine if there are any vitamin A deficiency in the community, and also to estimate the level of B- carotene in the various foodstuffs so as to promote their higher consumption towards elimination of any vitamin A deficiency.

Results of serum vitamin A analysis indicate that there is no serious vitamin A deficiency case in the community studied to warrant any vitamin A supplementation by means of vitamin A capsules. Of all the 263 subjects screened, only 0.8% had deficient level (i.e. 10ug/dl); 12% had low level of 10 - 20ug/dl; 83.7% had adequate level of 20 - 50 ug/dl, while 3.8% had high level of more than 50ug/dl. According to WHO recommendation, a community can be said to be a 'vitamin A deficient' society, and therefore needing immediate intervention measures by means of vitamin A capsules or injection, only if more than 5% of the target. Population have serum level of less than 10ug/dl.

Results so far obtained from nutrient intake show that energy intake is low - about 60% RDA. Even though protein intake was relatively high, the quality has to be investigated. This is necessary because the diet of the villagers is made up of different food items of both plant and animal origin.

The most significant observation so far made is the fact that vitamin A intake is abnormal subjects was higher in normal subjects. Even though other age groups are yet to be analysed, this shows that vitamin A intake in the subnormal subjects meet RDA levels but other factors might be lacking . Since the RBP and pre-albumin levels are below normal values in the subnormal group (table 2), this might, at least in part, explain the relatively low level of serum vitamin A in subnormal subjects.

The results presently available from analyses of the foodstuffs indicate that palm oil and the various leafy vegetables are rich sources of B-carotene and that their increased consumption through education would provide a cheap but effective means of overcoming any vitamin A deficiency due to insufficient dietary intake in a society. It must be stressed that, as seen from the result, care must be taken during food preparation so as not to destroy the B-carotene.

FUTURE WORK

(i) More food items would be analysed for B-carotene levels.

(ii) Different types of meals - including stews, gravies would be prepared using normal methods and B-carotene levels determined to know the amount available in edible forms.

(iii) To complete calculation of Nutrient intakes for the other age groups.

TABLE 1 VITAMIN A STATUS IN VARIOUS AGE GROUPS

+Classification	3 - 5 years (n = 47) No. and % of total population studied in age group	Mean value (ug/dl)	Range (ug/dl)	6 - 14 Years (n = 97) No. and % of total population studied in age group	Mean Value (ug/dl)	Range (ug/dl)
Deficient: 10ug/dl	2;4.2%	9	9 -9.9	0;0	-	-
Low:-10-20ug/dl	7;14.9%	19.4	18.9-19.8	16;16.5%	17.8	11.7-19.9
Adequate:20-50ug/dl	38;80.9%	27.9	20.7-45.9	80;82.5%	30.0	20.7-48.6
High: 50ug/dl	0	-	-	1;1.0%	77.4	-
	15 - 45 years	(n = 101)		45 Years	(n = 18)	
Deficient: 10ug/dl	0	-	-	0	-	-
Low: 10-20ug/dl	7;6.9%	19.3	14.4-19.8	1;5.5%	18.9	-
Adequate: 20-50ug/dl	87;86.1%	32.5	20.7-49.5	15;83.3%	37.5	25.2-49.9
High: 50ug/dl	7;6.9%	56.9	51-68.4	2;11.1%	52.3	50.7-54.0

+ According to United States Interdepartmental Committee on Nutrition for National Development. (WHO Technical Report Series, Geneva 1976 p.27)

TABLE 2. COMPARISM OF SERUM PROFILE IN SUBJECTS OF DIFFERENT VITAMIN A STATUS

Status	Vitamin A (ug/dl)	Protein (g/dl)	Triglyceride (mg/dl)	Pre-albumin (mg/dl)	RBP (mg/dl)	Glucose (mg/dl)
Deficient: 10ug/dl (n=2)	9.5	8.5	89.4	6.6	1.4	60.8
Low:-10-20ug/dl (n=24)	18.1	8.0	67.0	12.9	2.4	59.8
Adequate: 20-50ug/dl (n=20)	37.1	8.2	67.0	24.2	5.9	60.6
High: 50ug/dl	52	7.6	85.5	40	15	70.5
Recommended Level	20-50	6.7-8.2	-	10-40		60-120

TABLE 3. B-CAROTENE LEVELS IN SOME FOOD ITEMS

Sample	B-Carotene Concentration ug/100g
1. Oils	
Palm Oil (Madina Market)	95,400.89
Palm Oil (Malata Market)	69,610.42
Coconut Oil (Madina Market)	52.96
Coconut Oil (Malata Market)	8.00
Palm Kernel oil (Malata market)	96.50
Palm kernel Oil (Madina)	10.00
Shea butter (Malata)	53.46
Shea butter (Madina)	
Vegetable oil (Dinor)	164.64
2. Leaves	
Alfalfa - mature leaves (fresh)	28,400.00
Alfalfa - immature leaves (fresh)	14,251.00
Alfalfa dry leaves (tea)	341.72
Alfalfa leaves - boiled	4,558.0
Wild lettuce (fresh)	17,000.0
Wild lettuce (boiled)	1,744.0
Borkorborkor - fresh	4,700.0
Borkorborkor - boiled	3,500.0
Kontomire - fresh	5,226.23
Kontomire - boiled	600.36
Baobab leaves - dry	302.31
Baobab leaves - dry and boiled	8.49
Bu leaves - dry	1,266.75
Alafi leaves - dry	3,721.29
Alafi leaves - dry and boiled	
Berigens - dry	6,495.91
Berigens - dry and boiled	3,597.44

Oils were saponified with alcoholic NaOH at 80°C for 20min. prior to extraction of B-carotene. At least 5 samples of each commodity were analysed in triplicate. Boiling in each case was done for 10min with sufficient water to completely immerse the leaves.

TABLE 4.

	NORMAL SUBJECTS				ABNORMAL SUBJECTS (Low Serum Vitamin A Subject)		
Energy Intake							
AGE GP (Yrs)	No.	total energy (Kcal)	RDA	%RDA	No	KCal	%RDA
4 - 6	(2)	1426	1841	77	(4)	1199	65
7 - 9	(3)	1357	2192	62	(5)	1404	64

Table 5.

Protein Intake							
AGE GP (Yrs)	No.	total energy (g)	RDA	%RDA	No.	total energy (g)	%RDA
4 - 6	(2)	30.3	34	89	(4)	26.5	78
7 - 9	(3)	44.9	41	109	(5)	42.8	104

Table 6.

Mineral Intake (1)							
AGE GP (Yrs)	No.	Calcium mg	RDA	%RDA	No.	Calcium (mg	%RDA
4 - 6	(2)	250	450	56	(4)	180	40
7 - 9	(3)	281	450	62	(5)	261	58
Mineral Intake (2)							
		Iron				Iron	
4 - 6		16	10	164	(4)	13	130
7 - 9	(3)	14	10	144	(5)	15	150

Table 8:

	Normal Subjects				Low Serum Vitamin A Subjects		
VITAMIN INTAKE(1)							
AGE GP (Yrs)	No	B_1 mg	B_1 RDA	%RDA	No.	B_1 mg	%RDA
4 - 6	(2)	0.65	0.7	92	(4)	0.7	57
7 - 9	(3)	0.39	0.9	43	(5)	0.9	54
			(2)				
		B_2				B_2	
4 - 6	(2)	0.34	1.1	31	(4)	0.28	25
7 - 9	(3)	0.36	1.3	28	(5)	0.39	30
			(3)				
		Niacin				Niacin	
4 - 6	(2)	8.0	12.1	66	(4)	5.7	49
7 - 9	(3)	8.3	14.5	57	(5)	8.3	57
			(4)				
		C				C	
4 - 6	(2)	29.3	20	147	(4)	45.6	228
7 - 9	(3)	22.2	20	113	(5)	50.9	255
			(5)				
		Vitamin A				Vitamin A	
4 - 6	(2)	2960	500	592	(4)	3118	624
7 - 9	(3)	2128	667	319	(5)	2971	445

APPENDIX

NUTRITION UNIT

TITLE:	: ORAL REHYDRATION THERAPY
PRINCIPAL INVESTIGATOR:	J. YARTEY
CO-INVESTIGATORS:	K. HARRISON
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	DR. E.E.K. TAEYI
TECHNICAL STAFF:	E. QUANSAH
	Y.A. AKYEAMPON
	E. A. ODDO
DATE COMMENCED:	MAY 1988
DATE COMPLETED:	PARTLY COMPLETED MORE WORK TO BE DONE

INTRODUCTION:

Diarrhoea is recognised as a major cause of morbidity and mortality among children in many developing countries including Ghana. Dehydration from diarrhoea can be prevented by giving patients, by mouth, an adequate glucose-electrolyte solution. The standard mixture of glucose and salt (ORS) distributed by UNICEF is not available to most rural communities and in its absence, a simple sugar-salt solution, prepared in the correct concentrations, is equally effective for rehydration. The absence, however, of a standardised measure for the preparation of the sugar-salt solution in the home, results in the preparation of hyper- or hypotonic solutions which could be detrimental to the health of the already sick child. "Home-available" fluids, mainly cereal-based porridges could also be used to replace lost energy and electrolytes and has the added advantage of providing small amounts of other nutrients.

The aims of the project are therefore:

1. To estimate the sugar and electrolyte content of some home-available fluids used for rehydration.
2. To investigate the acceptability and effectiveness of these fluids to diarrhoea patients.
3. To investigate the frequency of use of these fluids and their acceptability to mothers.
4. To investigate mothers attitude to ORS using a questionnaire
5. To simplify and standardise the preparation of home-made sugar-salt solutions.

METHODS OF ANALYSES

Analyses have be done on at least thirty (30) samples each of Kenkey-water, rice-water and coconut water.

The analysis were done to determine the following in the fluids:

1. Sugar (monosaccharides) concentrations by Somogyi-Nelson Method.
2. Chloride concentration by Argentometric Titration.
3. Sodium and Potassium concentrations using the Atomic Absorption Flame Photometer
4. PH at 25°C using HORIBA pH meter.

The suitability of the concentrations of the 'home-available' fluids will be assessed by comparing them to those of the UNICEF ORS.

..... 2

Results of the Analyses of the "home-available" fluids:

Mean Concentrations of Simple Sugars and Electrolytes in Fluids

Sample	pH at 25°C	Simple Sugar g/l	Na+ mmol/l	K+ mmol/l	Cl- mmol/l
UNICEF ORS (Acceptable limits)	(7.0-8.8)	20.0 (18.6-21.4)	89.5 (83.2-94.0)	20.1 (18.7-21.5)	80.0 (74.4-85.6)
Kenkey water	2.9	1.8	9.5	20.4	111.5
(range)	(2.6-3.4)	(0.4-5.6)	(4.3-18.5)	(10.2-37.3)	(44.0-85.6)
Coconut water	4.7	46.1	0.3	73.6	64.6
(range)	(4.4-5.6)	(27.3-68.2)	(0.1-1.2)	(35.8-110.0)	(38.0-90.0)
Rice water	6.2	0.4	50.7	2.1	94.6
(range)	(5.0.6.7)	(0.3-0.6)	(14.3-62.6)	(1.2- 4.6)	(87.0-106.0)

Rice water - 100g rice in 1.5l water with 5g salt, 4g/100ml sugar and cooked for 40 minutes using a gas stove.

* - At least 30 samples of each fluid was analysed.

Q2 - 1. Percentage of mothers who give various treatments for diarrhoea

Treatment	%
ORS	29.1
Sugar-Salt solution	33.5
Enema	6.1
Drugs	17.3
Clinic	55.9
Home remedies	17.3

Q2 -2. Percentage of mothers giving various Home-available" fluids.

Home Remedies	%
Coconut water	32.2
Maize porridge	6.4
Millet porridge	3.2
Rice water	16.1
Kenkey water	16.1
Fruit juice	9.7
Boiled water from Guava leaves	16.1
Other foods	16.1

Q.3 - 1 Frequency of the duration of diarrhoea when no therapy is given

No. of Days	1-2	3-4	5-6	7-8	Total
No. of people	2	12	2	3	19
Percentage (%)	10.5	63.2	10.5	15.8	100.0

Q.3 - 2 Frequency of the duration of diarrhoea with different types of therapy

Therapy	1-2 days	3-4 days	5-6 days	7-8 days	9-10 days	Total No. subjects	Total %
ORS	50.6	30.1	8.4	9.6	1.2	83	52.5
Rice Water	66.7	33.3	-	-	-	3	1.9
Salt Solution	100.0	-	-	-	-	2	1.3
Coconut water	50.0	50.0	-	-	-	2	1.3
Drug	25.5	65.5	1.8	5.4	1.8	55	34.8
Sugar-Salt solution	58.3	41.7		-	-	12	7.6
Kenkey water	100.0	-	-	-	-	1	0.6

Q.5 Food intake during diarrhoea

	No.	%
Child eats well	63	44.1
ild does not eat well	80	55.9
Total	143	100.0

Q6 & & - Distribution of mothers who have heard of and seen ORS

Heard/Seen	No	%
YES	158	89.8
NO	18	10.2
Total	176	100.0

Q9 & 10 - Percentage of mothers who found ORS effective and are willing to recommend to others.

	No.	%
YES	112	75.7
NO	36	24.3
Total	148	100.0

Q. 11 - Frequency of occurrence of diarrhoea. (Total numbers of subjects = 152)

	1-2 times		3-4 times		5-6 times		7-8 times	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
a week	1	(0.7)	-	-	-	-	-	-
a month	42	(27.6)	4	(2.6)	-	-	-	-
a year	62	(40.8)	28	(14.4)	14	(9.2)	1	(0.7)

Kenkey Water:

The average potassium (K+) and Chloride contents of the kenkey water are close to that of the UNICEF ORS. Unfortunately the sodium concentration is too low and any attempt to increase the sodium level of the fluid by adding salt will cause an increase in chloride levels. It is necessary to find aout how best a reasonable level of sodium and potassium could be obtained in this fluid. The sugar level can easily be increased by adding sugar which is usually available in the home. The pH of the kenkey water is also too low, probably because of prolong fermentation of the corn dough before cooking. It may be necessary to analyse maize porridge as well as see how different it will be from the kenkey water. The kenkey water is likely to be an efficient fluid for ORT after a little improvement in its preparation to bring it closer to the UNICEF ORS.

Coconut Water:

The coconut water also has a relatively lower pH than expected as compared to the UNICEF ORS. The simple sugar content is relatively high but not high enough to pose any danger to the diarrhoea patient. The sodium content is extremely low and needs to be taken care of but any addition of salt to the Coconut water will increase the chloride content. Since the chloride content of the fluid is also low, a reasonable amount of salt added to the coconut water may improve its quality for use as oral rehydration therapy. The pottasium content of the coconut water is high and this has been reported to cause vomitting in already dehydrated diarrhoea patients., which is not favourable. It may be necessary to dilute the coconut water with some amount of water after adding some sodium chloride, in order to reduce its sugar and potassium contents to acceptable limits and increase the sodium and chloride levels to reasonable levels. The coconut water may then be very effective for rehydration.

Rice Water:

There pH of the rice water is reasonable compared to the UNICEF salts. The sodium and chloride levels are also reasonable and quite acceptable. The simple sugar and potassium levels are rather too low, and while the simple /sugar/ level could be altered by adding sugar which is

available in the home. How to increase the potassium level of this fluid remains a problem. Apart from the low potassium level, rice water seem to be a good substitute for the UNICEF ORS. It is important to find out how best the potassium content of this fluid can be increased.

All the three fluids investigated may be used for oral rehydration therapy with little alteration or modification.

Analysis of Questionnaire

Questionnaires were administered to one hundred and seventy nine mothers attending the (Princess Marie Louis (PML) children's hospital and the Labadi Polyclinic both in Accra.
The Analysis of the data revealed the following:

Q.1 - What is diarrhoea?

	Frequent Watery Stool	Others	Total
Number	171	2	173
Percentage (%)	98.8	1.2	100.0

Q.2 - 1 Percentage of mothers who give various treatments for diarrhoea

Majority of the mothers interviewed (94%) give adequate treatment to their children when they have diarrhoea. Sixty percent take the child to the clinic, 33% give home-prepared sugar-salt solution, 29% give UNICEF ORS and 17% give home-available fluids. It must be noted that some mothers give combined treatment such as giving the child ORS and taking him to the clinic.

Q.2 - 2. Percentage of mothers giving various "home-available" fluids.

The most frequently used fluids is coconut water, followed by rice water and kenkey water.

Q.3 - 1 Frequency of the duration of diarrhoea when no therapy is given.

Diarrhoea usually lasts about 3-4 days when no therapy is given

Q. 3 - 2 Frequency of the duration of diarrhoea with different types of therapy.

The remedies mostly used by the mothers were ORS, drugs and sugar-salt solution respectively. Of these, mothers claimed that diarrhoea was most effectively treated with sugar-salt solution and ORS followed by drugs. The few mothers who used the home-available fluids also claimed that they were very effective and stopped the

diarrhoea by the 4th day at worst.

Q.5 - Food intake during diarrhoea

Sixty percent of children have poor appetites when they have diarrhoea.

Q.6 & 8. Distribution of mothers who have heard of and seen ORS

Ninety percent (90%) of the mothers interviewed had heard of and seen UNICEF ORS while 72% have used it before.

Q. 9 & 10 Percentage of mothers who found ORS effective

Most of the mothers (75%) who had used the UNICEF ORS before found it effective in treating diarrhoea and would recommend it to others.

Conclusions and Recommendations:

It is recommended that more samples of the "home-available" fluids be analysed to assess their sugar and electrolyte contents. Of the three types that have been analysed, ways of improving their sugar and electrolyte content to make them more suitable for the treatment of diarrhoea must be investigated.

The traditional maize porridge and millet porridge need to be analysed to see if they can be used for rehydration. Other cereal based preparations that are popular in other parts of the country must be investigated and their use for rehydration assessed.

The education program on the use of ORS for rehydration is still on-going. It is necessary to find out if mothers are more familiar with ORS now than before and whether home-available fluids are als being used concurrently and how effective they find oral rehydration therapy.

In the future when the sugar and electrolyte contents of some home-available fluids have been found to be satisfactory and recommended, the effectiveness and acceptability of these fluids to diarrhoea patients will be investigated.

The sugar and electrolyte content of local beverages and other beverages such as mineral (fanta, Coke etc) will be estimated and their efficacy investigated.

APPENDIX

NUTRITIONAL STATUS OF THE CHILDREN IN A RURAL COMMUNITY IN THE UPPER EAST REGION OF GHANA

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INTRODUCTION AND BACKGROUND INFORMATION

Food situation in the Northern part of Ghana is widely recognized to be very poor and different from the Southern part. The higher incidence of Marasmus as compared to Kwashiorkor (1987 Annual Report of Bawku Rural Health Services) could be an indication of the generally poor food situation in the North. It is also believed that incidence of eye ailments in the South is less than in the North because of frequent use of foods rich in precursors of vitamin A in the South. Up to date, no reliable information has been gathered to support this assumption. This field research was carried out to examine the nutritional status of the children in a typical village in the Upper East Region of Ghana. The parameters used for the determination of the nutritional status were food intake and anthropometry.

AIM

The main aim of this project is to obtain basal and reliable information about the nutritional status of children and factors contributing to malnutrition in the Upper East Region in particular, and the Northern part of the country in general.

OBJECTIVE

1. To determine dietary intake of the population in general and children aged between 4 and 12 years in particular.
2. To determine anthropometric measurements of the population in general and children from 3 to 12 years in particular.

METHODS

Location:

Binaba was chosen as a typical village in the Upper East Region. This village is located in the Zebilla District of the Upper East Region of Ghana and it is about 50 km east of Bolgatanga, the regional capital. The village is about five kilometers square and has over two hundred houses. The inhabitants are predominantly Kusasis. The village has a Health Centre for the health needs of the people and those of the surrounding villages. Binaba Health Centre was chosen as the field research station to carry out anthropometric measurements and the accomodation of the investigators.

Dietary survey:

Twenty-seven (27) typical and cooperative families living around the field station were randomly selected. Daily dietary intake for 3 continuous days of all members of a family excluding breast-fed babies was recorded by an investigator staying in the selected house. Dietary recording of the selected families was carried out by 9 investigators; 3 from the Nutrition Unit of NMIMR and 6 nutrition field workers from the Centre.

Weights of all ingredients including water used for preparation of meals, together with the weights of prepared meals, were recorded. Dietary intake of each subject was measured as the difference between initial and final weight of every meal taken. Kitchen scales of 2 or 12 kg, depending upon the sample weight, were used for weighing each item.

Daily intake of each ingredient was calculated from the ratio in the cooked meal. For energy and nutrient intakes, the values from published od composition tables (attached to this report) were used.

Anthropometry:

Body weight, height, upper-arm circumference, tricep and subscapular skinfold thicknesses of children (3-12 years old) in this village and all subjects who participated in the dietary survey were measured.

Schedule

January	○ Field work for 5 days to collect back ground information.
	↑ Demographical survey,
	↓ Selection of subjects.
February	○ Field work for 2 weeks.
March	↑ Dietary survey,
	↓ Anthropometry.
April	○ Data Analysis (Summary and evaluation).
May	↑ Nutrient intake,
July	↓ Anthropometry.

RESULTS

Over 200 heads of families were interviewed for the collection of demographical information of the village. The summary of the Demographical data of Binaba obtained from questionaires is shown in tables 1-8. More than half of the households have between 6-15 members. About 43% of the population are aged 0-12 yrs, which is the target group of this study. Over 60% of the adult population of this village are small scale farmers. Illiteracy is also found to be very high, as shown in the tables.

Results of anthropometry of the randomly selected subjects (who were also subjects for the dietary survey) are shown in Tables 9a. and 9b. Mean body weight and height of these children were found to be about 80% and 90% of Harvard (for 2-5 years) or Iowa (6-12 years) Standards respectively. Similar low values were obtained in the other anthropometric parameters.

Results of the dietary survey of 189 subjects are shown in tables 10-15. Mean energy intakes for all the age groups did not vary much, being about 1200-1600 kcal/day, which is about 40-70% of RDA (Recomended Dietary Allowance published by FAO/WHO.). Mean protein intakes were 40-50 g/day For the 4-12 years old, it forms over 90% of RDA, while it is about 60-90%

RDA for the above 13 years old age groups. Millet, the staple food of this region, contributed about half of the total amount of protein consumed, while the animal protein portion was only about 5%. Iron intake was comparable to the RDA. Calcium intake was low, being about half of the RDA. Thiamin intake was comparable to the RDA. Riboflavin intakes were low, being about half of the RDAs. Wide individual variations of retinol intakes were observed among the subjects.

DISCUSSION

Undernourishment, especially of children is a common problem in developing countries. Since the severe forms of Protein-Energy Malnutrition (PEM)-Marasmus and kwashiorkor, are widespread in Ghana, subclinical cases of malnutrition, which are not easily identifiable, must be common. Results of this survey confirmed that energy and most of the nutrient intakes were below RDAs. Although the amount of protein consumed was comparable to RDA, the quality is very poor. Ingested protein therefore cannot be fully utilized to maintain proper growth under insufficient energy intake, as observed in the low anthropometric measurements. Low energy and nutrient intakes are an indication of the poor dietary situation in northern part of Ghana.

A favourable observation made during our stay was the frequent use of leaves (fresh ones in the rainy season and dry ones in the dry season), groundnuts and melon seeds. Wide variations were observed in vitamin intakes, especially vitamin A, being high in those who consumed more green leafy vegetables. Since these leaves are available and easily obtainable, their increased consumption could improve the mineral and vitamin status.

Generally, improvement of nutritional status results from an improved dietary intake, which is directly related to food availability. However, dietary intake is influenced not only by food availability itself but also by other factors such as socio-economic and nutritional knowledge. Our dietary survey undertaken in Southern Ghana, where food situation is not so

had, showed that the most effective means of improving the nutritional status of the children is nutrition education of their mothers. Results from this survey however, indicate that it is increased food availibility in the north. The probable cause of higher incidence of Marasmus in pre-school children in northern Ghana, when compared to their southern counterparts, may be due to the inadequate food intake during the lean seasons. Nutrition education alone will thus not be enough to solve the nutrition problems in the Northern Region and the Upper Regions of this country. It means that current dietary intake in each region together with environmental factors influencing it must be determined in order to set up the policy for the improvement of nutritional status in the particular region of the country. There are several other factors like weather condition, soil composition, water and so forth which contribute towards the yield per season. Appropriate simple agricultural practices and methods aimed at increasing food production and storage should therefore be introduced and sustained in the northern part of the country.

Table 1. Number of persons per household in Binaba

No. of persons	No. of households	%
1	1	0.4
2	5	1.9
3	10	3.8
4	20	7.6
5	30	11.5
6	29	11.1
7	25	9.6
8	25	9.6
9	23	8.8
10	10	3.8
11-15	43	16.5
16-20	25	9.6
21-30	12	4.6
31-40	2	0.8
41-50	1	0.4
Total	261	100.0

Total number of households = 261
Total number of houses = 217

Table 2. Age distribution in Binaba

Age	M	F	Total	%
(months)				
0- 5	22	20	42	1.7
6-11	11	21	32	1.3
12-23 (1yr)	31	38	69	2.7
24-35 (2yrs)	39	46	85	3.4
36-47 (3yrs)	47	59	106	4.2
48-59 (4yrs)	40	53	93	3.7
60-71 (5yrs)	53	43	96	3.8
(years)				
6-12	282	283	565	22.4
13-19	173	134	307	12.2
20-24	80	97	177	7.0
25-29	77	106	183	7.2
30-39	121	158	279	11.1
40-49	72	120	192	7.6
50+	137	158	295	11.7
Total	1185	1336	2521	100.0
(%)	(47.0)	(53.0)	(100.0)	

Table 3. Occupational distribution in Binaba

	Men		Women	
	No.	%	No.	%
Small scale farmers	479	79.7	484	60.7
Large scale farmers	1	0.2	-	-
Petty traders	28	4.7	224	28.1
Teachers	20	3.3	9	1.1
Artisans	14	2.3	6	0.8
Fishermen (of fish ponds)	4	0.7	-	-
Drivers	4	0.7	-	-
Housewives	-	-	73	9.1
Herdsmen & poultry farmers	8	1.3	-	-
Girl servants	12	2.0	1	0.1
Watchmen	11	1.8	-	-
Others eg. labourers Soothsayers etc.	20	3.3	1	0.1
Total	601	100.0	798	100.0

Table 4. Occupational problems of Binaba

Problems	No.	%
1. Financial *	85	31.6
2. Insufficient rainfall	88	32.7
3. Lack of farm inputs		
a. Fertilizer	15	5.6
b. Bullocks	2	0.7
c. Seeds	1	0.4
d. Implements	4	1.5
4. None	4	1.5
5. No answer	70	26.0
Total	269	100.0

* Financial problems:
a) No money for the following
i) Extention of farms
ii) Hiring of labour
iii) Farm inputs
b) And can't obtain loans from the banks

Table 5. Level of education (13 years & above) in Binaba

Level of education	Men		Women	
	No.	%	No.	%
Nil	253	66.9	377	92.6
Primary school	46	12.5	10	2.4
Middle school	36	9.8	14	3.4
Junior secondary school	7	1.9	3	0.7
Secondary school	12	3.3	1	0.3
Vocational school	4	1.1	1	0.3
Technical school, training school and university	9	2.5	1	0.3
Total	367	100.0	407	100.0

Table 6. Level of education of children aged 6-12 years in Binaba

Level of education	Men		Women	
	No.	%	No.	%
Nil	95	64.2	103	71.0
Primary school	50	33.8	39	26.9
Junior secondary school	3	2.0	3	2.1
Total	148	100.0	145	100.0

Table 7. Level of education of inhabitants aged above 6 years in Binaba

Level of education	Men		Women	
	No.	%	No.	%
Nil	348	67.6	480	86.9
Primary school	96	18.6	49	8.9
Middle school	36	7.0	14	2.5
Junior secondary school	10	1.9	6	1.1
Secondary school	12	2.3	1	0.2
Vocational school	4	0.8	1	0.2
Higher institutions	9	1.8	1	0.2
Total	515	100.0	552	100.0

Table 8. Religion of inhabitants aged above 6 years in Binaba

Religion	Men		Women		Both sexes	
	No.	%	No.	%	No.	%
Pagan	748	80.5	900	85.5	1648	83.2
Christian	118	12.7	91	8.7	209	10.6
Moslem	46	5.0	46	4.4	92	4.6
None	17	1.8	15	1.4	32	1.6
Total	929	100.0	1052	100.0	1981	100.0

FOOD COMPOSITION TABLE USED FOR BINABA NUTRITION SURVEY

NUTRIENT COMPOSITION PER 100g EDIBLE PORTION

Foodstuff	Moisture (g)	Energy (kcal)	Protein (g)	Fat (g)	CHO (g)	Ca (mg)	Fe (mg)	Thiam. (mg)	Ribo. (mg)	Niacin (mg)	Fiber (g)	Asc. Acid (mg)	Retinol (IU)	Ash (g)
1. Onion	90.4	35	1.0	0.1	7.6	15	0.3	0.03	0.01	0.1	1.6	5	0	0.4
2. Consumme-dried (maggie cube)	0.6	204	7.1	6.0	30.3	19	0.6	0.07	0.05	0.5	0.0	0	0	56.0
3. Red pepper(dried)	13.3	328	14.0	11.4	23.1	70	6.5	0.50	1.30	13.0	32.6	100	11000	5.6
4. Sood (dried)	4.7	578	19.8	51.9	15.3	1200	9.6	0.95	0.25	5.1	3.1	0	0	5.2
5. Herring(smoked)	39.8	391	23.1	31.1	0.1	150	1.7	0.01	0.35	5.0	0.0	0	0	7.9
6. Tea	6.0	-	20.6	2.5	32.1	470	17.4	0.10	0.80	10.0	10.9	0	500	5.2
7. Milk(evaporated)	74.0	138	7.0	8.0	10.0	252	0.1	0.04	0.34	0.2	0.0	1	510	0.7
8. Beef	56.4	271	20.3	18.9	1.7	15	3.5	0.02	0.14	7.6	0.0	0	0	2.7
9. Salt	1.9	0	0.0	0.0	0.0	60	0.0	0.00	0.00	0.0	0.0	0	0	98.1
10. Tomatoes	95.0	16	0.7	0.1	3.3	9	0.3	0.05	0.03	0.5	0.4	20	220	0.5
11. Millet	12.5	364	10.5	2.7	72.4	11	2.0	0.20	0.07	1.7	0.5	0	0	1.4
12. Groundnuts	1.9	567	26.6	49.5	16.7	50	1.7	0.23	0.10	17.0	3.0	0	0	2.3
13. Maize	14.5	350	8.6	5.0	68.6	5	2.3	0.30	0.10	2.0	2.0	0	0	1.3
14. Anchovies	19.1	324	44.0	4.4	24.7	800	3.7	0.02	0.24	8.2	0.0	0	43	7.5
15. Ashibata(alefi)	88.6	33	3.3	0.1	5.2	65	1.0	0.10	0.24	1.4	1.5	55	2100	1.3
16. Cowpeas	10.8	330	19.5	1.1	60.6	70	11.0	0.90	0.15	2.0	-	0	20	-
17. Chicken	73.0	139	19.0	7.0	0.0	15	1.5	0.10	0.15	9.0	-	0	0	-
18. Pito yeast	11.0	298	39.5	0.4	34.2	25	45.0	9.33	4.00	36.0	8.7	0	0	6.2
19. Okro (dried)	9.8	290	17.5	0.8	53.1	910	26.0	0.60	0.80	5.5	10.3	20	55	8.5
20. Neri	5.5	510	17.8	42.0	15.2	24	19.0	0.11	0.15	2.6	17.0	0	30	2.5

NUTRIENT COMPOSITION PER 100g EDIBLE PORTION

	Foodstuff	Moisture (g)	Energy (kcal)	Protein (g)	Fat (g)	CHO (g)	Ca (mg)	Fe (mg)	Thiam. (mg)	Ribo. (mg)	Niacin (mg)	Fiber (g)	Asc. Acid (mg)	Retinol (IU)	Ash (g)
21.	Dawadawa (fermented seeds)	25.5	430	30.3	30.4	8.7	240	27.0	-	-	-	2.6	-	-	2.5
22.	Bread (white)	37.0	240	7.7	2.0	51.0	37	1.7	0.16	0.06	1.0	0.3	0	0	1.7
23.	Bambara beans	10.0	345	19.0	6.2	57.0	62	12.0	0.47	0.14	1.8	4.8	0	17	3.4
24.	Voa(dried calyx of red silk cotton tree)	10.4	280	8.0	0.6	60.4	1670	7.0	-	-	-	11.8	-	-	8.8
24.	Sheabutter	0.0	900	0.0	100.0	0.0	0	0.0	0.00	0.00	0.0	0.0	0	0	0.0
25.	Biito(dried hibiscus leaves)	7.0	300	20.0	3.0	48.0	1841	12.5	-	-	-	13.0	-	-	9.0
26.	Kuka(dried baobab leaves)	9.0	314	11.5	3.7	58.8	2210	15.0	-	-	-	8.4	-	16183	8.6
27.	Kulikuli (groundnut rings)	8.6	430	30.0	19.4	34.0	62	23.0	-	-	-	3.0	-	-	5.0
28.	Guinea corn(white)	11.0	360	9.7	3.3	72.7	14	52.0	0.28	0.09	3.4	1.5	-	-	1.8
29.	Rice (brown)	11.5	350	6.4	0.4	80.4	18	20.0	0.36	0.06	5.2	0.4	-	-	0.9

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Table 9a. ANTHROPOMETRY OF BINABA SUBJECTS

AGE GRP (YRS)	BODY WEIGHT No	BINABA kg	%Std	HEIGHT No	BINABA cm	%Std
3M	7	12.5 ± 1.3	80	7	89.6 ± 4.6	90
3F	8	11.8 ± 2.3	77	8	89.0 ± 5.8	89
4M	4	12.4 ± 2.2	71	4	94.1 ± 8.3	88
4F	4	13.9 ± 3.2	79	4	93.6 ± 7.7	88
5M	8	17.8 ± 3.0	86	8	108.2 ± 7.4	95
5F	5	15.6 ± 3.9	78	5	103.8 ±10.1	92
6M	5	16.9 ± 2.2	73	5	108.4 ± 6.4	90
6F	5	16.3 ± 1.6	73	5	107.7 ± 3.3	90
7M	6	20.1 ± 2.8	78	6	117.7 ± 7.8	93
7F	2	19.5 ± 2.8	78	2	115.9 ± 8.8	93
8M	2	22.0 ± 3.5	77	2	121.8 ± 8.6	92
8F	6	21.4 ± 4.0	77	6	122.2 ± 9.3	94
9M	3	23.2 ± 1.8	74	3	127.4 ± 5.8	92
9F	1	27.0 ± 0.0	89	1	124.7 ± 0.0	92
10M	5	26.6 ± 1.9	78	5	135.0 ± 3.6	95
10F	4	22.8 ± 2.9	67	4	129.5 ± 3.3	91
11M	3	25.2 ± 3.0	67	3	129.4 ± 5.7	88
11F	2	31.5 ± 2.8	84	2	142.8 ± 4.0	96
12M	4	33.6 ± 6.1	84	4	141.9 ±10.0	93
12F	5	31.9 ± 6.2	75	5	140.9 ± 5.3	91
13-15M	4	28.5 ± 4.9	-	4	138.2 ± 6.0	-
13-15F	7	45.7 ±11.5	-	7	155.7 ± 7.4	-
16-19M	5	36.0 ±11.5	-	5	149.4 ± 8.1	-
16-19F	3	45.2 ±22.2	-	3	144.8 ±26.3	-
20+M	30	55.7 ± 7.2	-	30	169.0 ± 7.2	-
20+F	52	50.9 ± 8.9	-	52	159.4 ± 6.8	-

Table 9b.

AGE GRP (YRS)	ARM CIRCUMFERENCE No	cm	SKINFOLD THICKNESSES SUBSCAPULAR No	mm	TRICEP No	mm
3M	7	15.0 ± 0.6	7	6.7 ± 2.6	7	8.3 ± 1.8
3F	8	14.9 ± 1.5	8	6.8 ± 2.5	8	9.9 ± 2.6
4M	4	14.4 ± 1.6	4	5.5 ± 2.9	4	7.3 ± 2.2
4F	4	15.5 ± 1.0	4	8.0 ± 1.8	4	10.8 ± 2.4
5M	8	15.7 ± 1.3	8	6.0 ± 1.9	8	6.9 ± 2.4
5F	5	15.5 ± 1.7	5	5.4 ± 1.5	5	7.6 ± 2.1
6M	5	15.0 ± 1.8	5	4.6 ± 1.3	5	6.4 ± 1.1
6F	5	15.4 ± 0.9	5	6.4 ± 1.1	5	7.6 ± 1.3
7M	6	16.1 ± 0.7	6	5.2 ± 1.2	6	5.7 ± 1.6
7F	2	16.8 ± 1.1	2	8.5 ± 3.5	2	9.0 ± 2.8
8M	2	16.5 ± 0.7	2	5.5 ± 2.1	2	6.0 ± 1.4
8F	6	17.1 ± 1.6	6	6.0 ± 1.9	6	6.5 ± 2.3
9M	3	17.1 ± 0.5	3	5.7 ± 2.1	3	6.3 ± 2.5
9F	1	20.5 ± 0.0	1	11.0 ± 0.0	1	13.0 ± 0.0
10M	5	16.9 ± 1.9	5	5.2 ± 1.3	5	6.4 ± 2.3
10F	4	17.6 ± 1.5	4	5.3 ± 2.5	4	6.8 ± 2.2
11M	3	16.8 ± 1.1	3	5.0 ± 1.0	3	4.7 ± 2.1
11F	2	19.3 ± 0.4	2	5.0 ± 1.4	2	4.5 ± 2.1
12M	4	17.7 ± 4.0	4	7.5 ± 2.6	4	7.3 ± 1.7
12F	5	19.3 ± 1.9	5	6.6 ± 1.5	5	8.0 ± 1.6
13-15M	4	18.2 ± 1.7	4	4.5 ± 1.7	4	6.0 ± 2.4
13-15F	7	23.3 ± 2.6	7	9.6 ± 4.2	7	10.1 ± 7.0
16-19M	5	19.7 ± 2.8	5	6.8 ± 1.8	5	5.0 ± 1.6
16-19F	3	23.6 ± 6.8	3	14.7 ± 8.0	3	15.7 ± 9.0
20*M	30	26.2 ± 2.5	30	9.0 ± 2.8	30	5.5 ± 2.3
20*F	52	26.1 ± 2.7	52	11.2 ± 6.3	52	10.8 ± 6.2

Table 10. ENERGY INTAKE

AGE GROUP (Yrs)	No.	TOTAL ENERGY (kcal)	%RDA	MILLET ENERGY (kcal)	%RDA	% TOTAL
4- 6	(34)	1289 ±427	70	770±375	42	61
7- 9	(21)	1425 ±402	65	857±307	39	61
10-12M	(13)	1344 ±321	52	843±240	32	63
10-12F	(11)	1369 ±379	58	743±396	32	56
13-15M	(4)	1266 ±598	44	912±578	32	72
13-15F	(8)	1639 ±571	66	869±583	35	53
16-19M	(6)	1448 ±548	47	854±512	28	59
16-19F	(3)	1393 ±422	60	683±282	29	49
20* M	(32)	1526 ±532	51	959±469	32	63
20* F	(57)	1285 ±523	58	792±494	36	62

Table 11. PROTEIN INTAKE

AGE GRP (Yrs)	No.	TOTAL PROT (g)	RDA	%RDA	ANIMAL (g)	%TOTAL	MILLET (g)	%TOTAL
4- 6	(34)	43.3 ±17.1	34	127	3.5 ±5.4	5.6±9.2	22.9 ±13	53.5±18.9
7- 9	(21)	46.9 ±16.0	41	114	2.9 ±3.4	5.6±6.5	25.2 ± 9	54.4±16.0
10-12M	(13)	43.1 ±10.3	50	86	2.7 ±2.5	6.9±7.9	23.9 ± 8	55.6±14.5
10-12F	(11)	45.2 ±10.4	48	94	2.1 ±2.3	4.5±4.8	22.3 ±13	49.8±22.1
13-15M	(4)	39.3 ±16.7	62	63	2.2 ±1.4	7.5±6.5	23.5 ± 8	59.7±20.8
13-15F	(8)	49.5 ±19.3	52	95	2.3 ±3.2	3.8±4.6	25.4 ±14	51.4±27.7
16-19M	(6)	47.9 ±19.9	63	76	3.1 ±3.4	6.0±5.3	26.1 ± 5	54.4±10.6
16-19F	(3)	45.6 ± 6.5	50	91	1.6 ±1.4	3.4±2.9	19.7 ± 6	43.3±12.1
20* M	(32)	50.5 ±18.0	62	81	4.9 ±6.0	8.7±9.0	28.1 ±13	55.3±23.9
20* F	(57)	41.7 ±17.4	48	87	2.5 ±5.4	5.0±6.6	22.8 ±14	54.9±23.6

Table 12. MIRERAL INTAKE

AGE GRP (Yrs)	No.	CALCIUM mg	RDA	%RDA	IRON mg	RDA	%RDA
4- 6	(34)	329±297	450	73	18± 7	10	180
7- 9	(21)	394±291	450	88	20±12	10	200
10-12M	(13)	288±221	650	44	20± 8	10	200
10-12F	(11)	341±222	650	52	19± 8	24	79
13-15M	(4)	342±414	650	53	12± 7	18	67
13-15F	(8)	527±426	650	81	21±10	24	88
16-19M	(6)	320±180	550	58	21±10	9	230
16-19F	(3)	341±176	550	62	21± 2	28	75
20* M	(32)	346±350	450	77	20±10	9	222
20* F	(57)	324±236	450	72	16± 9	28	57

Table 13. VITAMIN INTAKE (1)

AGE GRP (Yrs)	No.	B_1 mg	B_1 RDA	B_1 %RDA	B_2 mg	B_2 RDA	B_2 %RDA
4- 6	(34)	1.08±0.43	0.7	154	0.41 ±0.15	1.1	37
7- 9	(21)	1.13±0.37	0.9	126	0.42 ±0.15	1.3	32
10-12M	(13)	1.27±0.60	1.0	127	0.46 ±0.22	1.6	29
10-12F	(11)	1.10±0.30	0.9	122	0.43 ±0.12	1.4	31
13-15M	(4)	0.89±0.56	1.2	74	0.34 ±0.13	1.7	20
13-15F	(8)	1.10±0.32	0.9	122	0.41 ±0.16	1.5	27
16-19M	(6)	1.09±0.64	1.2	91	0.40 ±0.16	1.8	22
16-19F	(3)	1.25±0.25	1.0	125	0.41 ±0.12	1.4	29
20* M	(32)	1.34±1.30	1.2	112	0.49 ±0.19	1.8	27
20* F	(57)	1.02±0.47	0.9	113	0.38 ±0.70	1.3	29

Table 14. VITAMIN INTAKE (2)

AGE GRP (Yrs)	No.	NIACIN mg	NIACIN RDA	NIACIN %RDA	C mg	C RDA	C %RDA
4- 6	(34)	10.3±4.6	12.1	85	11.2 ± 9.4	20	56
7- 9	(21)	10.3±3.5	14.5	71	11.4 ±10.9	20	57
10-12M	(13)	10.6±3.3	17.2	62	12.5 ± 7.8	20	63
10-12F	(11)	10.1±2.8	15.5	65	9.5 ±11.3	20	48
13-15M	(4)	7.9±4.1	19.1	41	18.9 ±23.4	30	63
13-15F	(8)	10.3±4.4	16.4	63	14.1 ±16.2	30	47
16-19M	(6)	11.9±5.1	20.3	59	19.0 ±16.7	30	63
16-19F	(3)	11.2±2.9	15.2	74	11.0 ±11.3	30	37
20* M	(32)	11.2±5.3	19.8	57	10.9 ±10.7	30	36
20* F	(57)	8.8±4.5	14.5	61	7.9 ± 8.2	30	26

Table 15. VITAMIN INTAKE (3)

AGE GRP (Yrs)	No.	VITAMIN A I.U.	VITAMIN A RDA	VITAMIN A %RDA
4- 6	(34)	628 ±494	500	126
7- 9	(21)	591 ±598	667	89
10-12M	(13)	384 ±196	958	40
10-12F	(11)	675 ±707	958	70
13-15M	(4)	448 ±407	1208	37
13-15F	(8)	549 ±781	1208	45
16-19M	(6)	477 ±248	1250	38
16-19F	(3)	1198 ±876	1250	96
20* M	(32)	529 ±439	1250	42
20* F	(57)	452 ±528	1250	36

DEMOGRAPHY OF TAMPURO/SUMBRUNGU

The above mentioned data was collected between the 29th of May and 5th of June 1990 involving four Nutrition Technical Officers in the Upper East Region as field workers and supervised by the Regional Nutrition Officer.

Team Members

1. Miss Fati Wasai
2. Miss Veronica Ayawgka
3. Mr. Albert Atanga
4. Mr. Philips Anum

Supervisor : Mr. James Asedem

A total number of 103 houses were coverd within which were 165 households.

Approach

For practical convenience, the village was divided into two sections, A and B. The two sections were separated by a third class road which runs through the village.

All houses in the A section were numbered with the letter A preceding the number for a particular house. Similarly the B section was so numbered. The number for each house was marked with paint onto a wall. Two days were used for marking the houses and the actual data collection was done in five days.

General Information

The village of Tompuro is a section of Sumbrungu and lies 5 km off the Bolgatanga/Navrongo road to the north. It is 14 km from the capital Bolgatanga.

Settlement

The settlement of the sealtered type with individual houses separated by long distances up to 1 km.

Ethnicity

The inhabitants here are all of Grunshi extraction and they speak Gruni.

Houses

There are mud houses with round huts and occassionally rectangular rooms. They are roofed either with thatch or mud but very few aluminium roofs.

Sources of Water

The village which is about 3 km² uses water from 3 bore holes sited there. A few families rely on surface and well water.

Agriculture

The landscape in Tampuro is a flat one with large valleys which are fertila and are needed for cultivating rice, guinea corn, millet, groundnut, beans and maize.

The people also encourage livestock rearing and poultry keeping.

Accounts

A total of ¢ 77,500 was received for the data collection and this was used as follows:

Allowances for field stuff	¢ 62,500
Fuel	8,800
Stationary	6,200
Pencils	(200)
Erasers	(100)
Sharpner	(200)
Paint	(5,400)
Clips	(300)
Total	¢ 77,500

RESEARCH PROPOSAL

Title: NUTRITIONAL STATUS OF PRE-SCHOOL CHILDREN IN RURAL UPPER EAST GHANA.

Principal Investigator: Dr. I. BIKINABU

Co-Investigators: Dr. E. ARMAR-KLEMESU
Mr. Y. KIDO
Dr. E. E. K. TAKYI
Mrs. L. A. BRAKOHIAPA
Mr. E. HARRISON
Mr. D. O. KENNEDY
Miss. J. YARTEY

Technical Staff: Mr. E. ADDO
Mr. E. QUANSAH

Collabrators: Dr. T. KIYANO (The University of Kumamoto)
Dr. W.H. GANDAH (Regional Medical Officer, Ministry of Health)
Mrs. R. AGBLE (Nutrition Division, Ministry of Health)
Mr. J. ASEDEH (Regional Nutrition Officer, Ministry of Health)

Duration of project: 1 year

Project Date of Commencement: July, 1990

INTRODUCTION

There are various nutritional problems, particularly protein-calorie malnutrition and vitamin A deficiency, in Ghana as well as other developing countries(1-3). In order to solve these problems some efforts are being made by health workers and researchers of the Ghana government and other international organizations. The prevalence of these nutritional disorders varies in different parts of the country, e.g. it is assumed that vitamin A deficiency and marasmus tend to occur in the northern parts more than in coast areas(1). There are, however, few data on the nutritional status of the people of northern Ghana. This is because the condition for carrying out the survey is severe: the northern part of Ghana is about 400 to 600 km from the capital, Accra, and research facilities there are not sufficient. A nutritional survey undertaken by Dr. Shizuka (Nutrition Unit, NMIMR) in Binaba, a village in the Upper East Region in 1989 indicated that the people had quite low food intakes (4). Therefore, it is expected that marginal malnutrition or certain nutritional disorders may be prevalent.

In this study we are going to survey not only dietary intakes, but also anthropometry and some biochemical indices so that the nutritional status and other nutritional problems of pre-school children in the study area could be further clarified. The survey will be carried out in two different seasons to compare the nutritional status and the prevalence of specific nutritional disorders during the pre- and post-harvest seasons.

AIM

The aim of this study is to investigate the nutritional status and the prevalence of nutritional disorders of the pre-school children in rural Upper East Ghana through a dietary survey, anthropometric study and blood analysis and to provide these data as base-line reference for evaluating any future interventions.

GENERAL OBJECTIVE

To evaluate nutritional status by blood analysis, dietary intake and anthropometry.

SPECIFIC OBJECTIVES

(1) To investigate the prevalence of PEM through anthropometric studies.

(2) To determine serum protein, albumin, rapid turnover proteins (RBP, transferin and prealbumin) and vitamin A levels.

(3) To measure dietary intakes in order to determine the dietary habits and assess the levels of protein, energy and pro-vitamin A intakes.

(4) To ascertain the extent of seasonal differences in the parameters measured.

METHOD

In consultation with the regional medical officer and regional nutrition officer, three rural communities in the Upper East Region will be chosen in a feasibility study. When starting the study, the purpose and procedures of the

study will be explained to the parents of the [illegible]
this will elicit the necessary co-operation and compliance.

(1) Anthropometric study

For the anthropometric study, all the preschool children (0-5years old) from the three communities will be measured. Their height, weight, skin fold (triceps, subscapular and suprailiac), circumferences of chest, head, mid-upper arm, thigh, mid-calf and abdomen will be measured. Callipers with fixed pressure will be used for measuring skin fold. These measurements will be taken three times by the same person and the mean values recorded. The data will be compared with the National Centre for Health Statistic (NCHS) Standards (5) to estimate the level of growth. In addition, the prevalence of marasmus and kwashiokor will be checked using these records.

(2) Blood test

For blood test, the samples will be collected from all the preschool children of 3 to 5 years old in the three rural communities. 1.0ml of blood will be collected into a microtainer. After collecting blood, the sample will be carried to the Hospital at Bolgatanga and then haematocrit will be determined. The blood will be centrifuged to separate the serum which will be kept in the hospital's freezer until it is transfered to the Noguchi Institute. In our laboratory, total protein (6), albumin (7), prealbumin (8,9) transferin (8, 9) and retinol binding protein (9) in serum will be determined to investigate the relationship with the results of anthropometry and protein and energy intakes. Serum vitamin A will also be determined by HPLC (10).

(3) Dietary survey

We will recruit 50 preschool children(3-5 years old) in one community. The sampling procedure adopted will be a random selection of alternate

households with preschool children. Investigators will visit each house early in the morning before breakfast and follow them until the subjects go to bed to measure their dietary intake all day. The dietary survey will be continued for 3 days for each subject. The weight of each ingredient and water for cooking as well as that of the cooked food will be determined. The meal dished out for each individual will be weighed before and after eating. Through these records the intake of each ingredient can be calculated. Subsequently, the energy and nutrient intakes will be calculated from food composition tables(11, 12).

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PROJECT COST

(1) Reagents

These are available in the unit.

Potasium sodium tartrate	500g	3,200
Copper sulfate	500g	3,200
Potasium iodine	25g	1,400
Serum protein standard	10ml	2,000
Sodium hydroxide	500g	1,200
Potasium cyanide	25g	1,200
Haemoglobin standard	10ml	1,000
Brom cresol green	25g	1,600
Citrate acid	500g	2,000
Agar(Paltigen plate)	100g	5,000
Standard human serum	1.5ml	15,000
Plasma protein standard	0.5ml	10,000

Control serum	0.5ml	6,000
Serum protein standard	0.5ml	6,000
Ethanol	10 L	14,000
L-ascorbic acid	100g	4,800
Pyrogarol	100g	8,000
Potasium hydroxide	500g	1,400
	Sub total	¢ 89,000

(2) Stationary

These items have been provided by JICA.

Note books	10p	1,000
Ball-point pen	12p	1,200
Pencil	20p	1,000
Erasor	20p	2,000
	Sub total	¢ 5,200

These are not available in the unit.

10ml disposable syringes	1 bx	5,000
5ml sample tube	600p	6,000
	Sub total	¢ 11,000

(3) Transport

This will be provided by JICA.

NMIMR - Bolgatanga, 4 trips

¢ 65/km X 1200 km X 4 trips = 312000 312,000

Sub total ¢ 312,000

(4) Overtime allowance

This will be provided by JICA.

Night allowance = ¢ 3000/1 night/person

21 days X 5 persons X ¢ 3000 X 2 times

= 630000 ¢ [illegible]

Sub total ¢ [illegible]

(5) Incentives

Those will be provided by JICA.

Each subject-one soap(¢ 50). [illegible] ¢ 140 X

¢ 200 X 300 X 2 times ¢ [illegible]

Salary for cook

¢ 10,000 X 2 times ¢ 20,000

Sub total ¢ [illegible]

(6) Equipment

These are available in the unit.

Height measure (stadiometer)	2
Weight scale	2
Callipers	3
Food scale	12
Plastic plate	50
Measuring tape	2

Total budget ¢ [illegible]