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FOOD AND NUTRITION JOURNAL OF TANZANIA

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EDITORIAL

Malnutrition, and in particular, undernutrition still, continues to be a major health problem of economic significance in developing countries. This is so as poor nutrition interferes with the formation of the human capital, which is the cornerstone of any nation's social and economic development.

Even temporary food shortages can have adverse outcomes both to adults and children; although the nutritional status of children needs to be given serious attention.

A number of interventions, both short and long-term, have been developed to address the problem. These include supplementation, food based approaches, improvement on the delivery of the social services and the improvement of the social-econamic situation in general.

The improvement of the social economic status has a much more lasting effect on the prevention of undernutrition and that is what all communities should strive for.

However, food based approaches have a long-term impact on the elimination and prevention of undernutrition. Hence both food scientists, technologists and nutritionists should come with food based approaches which can be applied at the household level within the means of a given household.

This issue of the Lishe Journal is discussing some of the food based approaches which have been developed and tested in Tanzania.

It is our hope that the readers can apply these approaches to assist the need and/or adopt them and further develop them for the nutritional benefits of communities.

We look forward to more findings from other scientists in this field.

Dr. W. Lorri
Chief Editor

PROXIMATE COMPOSITION OF UPUPU *(Mucuna poggei)*

E.M. Urio, G.T. Ndunguru, J. Amiri, F. Sogomba

Tanzania Food and Nutrition Centre

Abstract

The proximate composition of **upupu** ***(Mucuna poggei)***, a wild legume consumed in Masasi district, Mtwara region was determined using standard Association of Official Analytical Chemists (AOAC) methods. The moisture content of the seed was found to be 10.3 percent wet weight. The protein, carbohydrates, fat and ash content of the raw beans on a dry weight basis was 23.7 percent, 54.95 percent 4.9 percent and 3.6 percent respectively.

The legume was found to be similar in proximate composition to the beans commonly eaten by local community in this country. It was also noted that the bean could qualify as a food security crop if other factors such as cookability and anti-nutritional factors are controlled. Recommendations for further work were also stipulated. These included reduction of cooking time which, normally, takes about 12 hours with high demand for water, firewood and labour and characterisation of inherently toxic factors.

*Key words: **upupu** beans ***(Mucuna poggei)***, proximate composition, nutritive value.

Introdution

One way of improving food security in the household is by broadening the food base with known forest food products. Some forest food products have characteristic features suitable for drought and storage and also have good nutritional qualities. However, little attention has been paid to the identification and exploitation of such potentials.

Upupu *(Mucuna poggei)* which is one of the lesser known wild legumes is widely consumed by indigenous people in Masasi district, Mtwara region. Processing methods, nutritional qualities and agronomic conditions have not been documented partly because most efforts are directed to the exotic food crops. It was noted that under the traditional way of cooking, the bean takes about 12 hours with high demands for water, firewood and labour. These can pose negative effect to the environment and increase women's workload since it is women who are involved in the preparations. The fact that there are people already using **upupu** as part of their diet stimulated the need for its investigation.

This paper reports on some of the nutritional qualities of the **upupu** beans.

Sampling and sample processing

Upupu seed samples were collected from four households in Masasi district. Portions of these seeds were milled into flour by using a mill machine.

Analytical Methods

The recommended methods of the Association of Official Analytical Chemists (AOAC 1973) were used for the determination of moisture, ash, crude fat, crude protein and crude fibre.

Ash was determined by incinerating a known weight of sample in a muffle furnace at 600^0 C for four hours.

Crude fat was determined by exhaustively extracting a known weight of sample with petroleum ether and di-ethyl ether (b. p 40^0 -60 C), using a soxhlet apparatus.

Protein (N x 6.25) was determined by the Macro-Kjeldahl method. Crude fibre was determined by the acid and alkaline digestion methods.

Carbohydrate was obtained by the difference method, that is by subtracting the sum of the protein, fat, ash and fibre from the total dry matter.

The calorific value was obtained by multiplying the mean value of the crude protein, fat and carbohydrate by the Atwater factors of 4, 9 and 4 respectively, taking the sum of the products and expressing the result in kilocalorie.

Results and discussion

Investigation was carried out to determine some of the nutritional qualities of **upupu** widely

consumed by people of Masasi district. Table 1 shows the proximate composition of 'upupu' beans.

Table 1: Proximate composition of the beans (% dry matter)

Constituent	Raw Sample
Moisture	10.3
Ash	3.6
Fat	4.9
Protein	23.7
Carbohydrates	55.0
Fibre content	2.6
Calorific value (kcals/100g)	358.7 kcals

The moisture content of the bean was within the range of other *Mucuna spp.* such as velvet beans. The range is between 8.6 and 14.5 percent (FAO, 1968). The low moisture content is an indicator that the legume can be stored for a long time without spoilage should the storage environment be ideal.

The crude fat content does not qualify the bean as an oil-rich legume, especially when compared with groundnuts and soyabeans which have fat contents about 40 percent and 19 percent respectively (Oyenuga 1968, FAO 1968).

The protein content of **upupu** was 23.7 percent. This value is comparable to that of cowpeas and kidney beans which have 23 percent and 22 percent respectively (CTA/ECSA, 1987).

The carbohydrate content of **upupu** is relatively high, 55 percent compared to groundnut and soyabean which have values of 23 and 34 percent respectively (FAO, 1968). However, most common legumes consumed in Tanzania have higher carbohydrate values than **upupu**. The calorific value of the raw sample is about 358.7 kcals. This indicates that about 836.4g of the **upupu** beans can provide the daily requirements of between 2500 to 3000 kcals for adults (Bingham, 1978).

When **upupu** is properly processed to improve cookability and reduce antinutritional factors which are known to be present, it will qualify as a potential food security crop.

Conclusion

Based on the proximate analysis findings, **upupu** beans are a good source of protein and carbohydrates and can make valuable contributions to the human diet.

However, the following observations and suggestions are made to help determine the suitability of the observations:

(1) There may be some antinutritional and toxic factors in **upupu** beans. There is a need to carry out further characterization of the bean to determine these factors;

(2) The present cooking time for the beans is approximately 12 hours. This process utilizes a lot of firewood and water. There is need to explore methods that will reduce the cooking time of the bean and inactivate the antinutritional and toxic factors; and

(3) It is not known what percentage of the population in areas where the bean grows accepts it as a food crop. There is, therefore, a need to carry out knowledge, attitude and practise (KAP) studies on this issue.

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EFFECT ON NUTRITIVE VALUE OF BULRUSH MILLET

R.R. Kingamkono.

Tanzania Food and Nutrition Centre, Tanzania

ABSTRACT

The effect of traditional dehulling and germination on chemical composition was studied in bulrush millet (*Pennisetum typhoides*).

Crude protein, lysine, iron and zinc increased, crude fat and proline decreased other germination. There was a substantial reduction of most nutrients after dehulling the ungerminated cereals. Most of these nutrients were recovered in the bran fraction. Germination increased dietary fibre. Lysine was the most limiting amino acid (53%). Other amino acids were less affected.

Dehulling causes nutrient loss. Germination is a useful process because it results in increased micronutrients of nutritional importance and improved protein quality.

*Key word: Bulrush millet, food processing, dehulling, germination, nutrients.

INTRODUCTION

Protein-energy-malnutrition (PEM) is a serious nutritional problem in Tanzania affecting mostly the pre-school children. The immediate causes of malnutrition in Tanzania are low food intake and recurrent diseases. The low food intake, especially among young children, is compounded by high dietary bulk of food given to them and low feeding frequency. The two factors work synegistically resulting into low daily nutrient intake. Moreover, nutrients lost during food processing and preparation render the final food consumed to have very few nutrients left aggravating the inadequate daily nutrient intake.

Bulrush millet is one of the main staple foods in drought prone regions of Tanzania where together with sorghum, it provides more than 70 percent of the total energy intake (Mosha 1985). Bulrush millet is reported to be equal or sometimes superior to other cereals in nutrient content (Badi, Hoseney & Casady, 1976; Hulse, Laing & Pearson, 1981; Desai & Zende 1979).

In Tanzania, traditional processing of bulrush millet involves dehulling or germination before it is made into flour which is later prepared into either soft porridge or stiff porridge as a staple. Normally, dehulling results in nutrient loss whereas germination improves the quantity and quality of some of the nutrients in grain foods (Hulse, 1981). No study reports the effect of traditional dehulling or germination of bulrush millet in Tanzania . This study was carried out to determine the effect of traditional dehulling and germinating bulrush millet on the nutrient content.

MATERIALS AND METHODS

A commercial sample of local bulrush millet variety was obtained from a food market in Dar es Salaam. After washing, some grains were air dried at 50^0 C and the remaining were soaked overnight. Germination was then done at room temperature (20^0 C) and samples drawn after 48 and 72 hours. Germination was followed by air drying.

Sample processing and preparation

Half of the ungerminated grains was dehulled in a laboratory using a traditional mortar and pestle to produce 80 percent and 63 percent dehulled grains. These were washed before air drying. The bran from the 80 percent extraction rate was air dried and kept for analysis. All the samples were then milled using a plate mill (Falling number AB, Stockholm, Sweden). Flour obtained from ungerminated whole grain was used as controls.

Chemical analysis

Proximate analysis was done using the Association of Official Analytical Chemists (AOAC) method (Horwits, 1975). Amino acid composition was examined using an ND-1200-E amino acid analyser (Nilov & Pyzhov, 1976). Dietary fibre and starch was determined according to Theander (1983).

Data analysis was done using simple calculations and mean values presented.

RESULTS AND DISCUSSION

Protein content

Crude protein was lowest (12.2%) in the most refined flour and highest (16.8%) in the bran (Table 1). Germination raised the protein content

by 7 percent and decorticating lowered the same by 9 and 10 percent in the 80 percent and 63 percent extraction rates respectively.

Values of crude protein content observed in the whole ungermination flour samples fall within the reported values in the literature for bulrush millet which range from 8 - 23 percent (Desai and Zende, 1979).

The increase in protein content after germination is mainly due to dry matter loss as the carbohydrates are catabolized to supply energy for the growing seedling (Wu, 1980), and partly due to protein synthesis as new tissues are formed during seedling growth (Ranhotra, Loewe & Puyat, 1977). Increased protein content in germinated bulrush millet was also reported by Opoku, Ohenhen & Elijfor, (1981). The same observation in other grains was reported by Taylor (1983).

The loss observed in decorticated flour is due to the fact that most of the protein in bulrush millet is concentrated in the aleurone layer and germ (Hulse et al. 1981). These portions normally get removed along with the pericarp during dehulling. This also explains the high content of protein in the bran fraction. High protein losses after dehulling bulrush millet was also reported by Badi et al (1976).

Fat content

The fat content (6.2%) in the ungerminated whole flour sample (Table 1) is within reported ranges (2.8 - 8%) (Baleia, Varriano-Marston & Hoseney, 1980) De Fransisco, Shepherd, Hoseney & Varriano-Marston, 1982). The highest refined flour had the lowest amount of fat (4.2%) and bran had the highest amount of fats (13.4%) (Table 1). Germination reduced fat content by 8 percent in the 48 and 73 hours germination respectively while dehulling caused a loss of 31 percent of fats.

The reduced amount of fats after germination is due to catabolization to provide energy to the growing seedling. Opoku et al. (1981) observed a reduction of 67 percent, in oil content after germinating bulrush millet for 84 hours. Keylen and McCready (1975) observed the same effect in germinating soyabeans. Like protein, fats in bulrush millet are also concentrated in the aleurone layer and germ (Hulse et al 1981). The removal of such portions during decortication therefore, leads to loss of fats.

Amino acid and chemical score

Lysine was the most limiting amino acid in all samples which scored only 53percent in the whole ungerminated flour (Table 2). Germination increased lysine chemical score to 62 percent and 74 percent after 48 and 72 hours germination respectively. The scores of other amino acids were all above 90 percent.

Dehulling had a negative effect on the chemical score of lysine reducing it to below 50 percent. The other amino acids showed minor changes.

The increase in amino acids after germination is a result of proteolytic activities which increase during germination (Piendl & Wagner 1972). As germination proceeds, the amino acids increase progressively until they reach a maximum point and then start to decline. The pattern of increase and decline varies from different amino acids (Piendl et al. 1972). The decrease at a later stage of germination is partly due to their being used for synthesis of new tissues of the growing seedling (Hegazi, 1974) and partly due to transamination (Tylor 1983).

The above account explains the variable changes of amino acids observed after germination. Of much importance, however, is the increased lysine after germination reflecting an improved protein quality as indicated by the increase in its chemical score from 53 percent in the ungerminated whole flour to 74 percent after 72 hours germination. A similar observation was reported by Hegazi (1974) in other cereals and Wu (1980) in legumes.

The removal of the outer layers which include aleurone layer and germ during dehulling accounts for the loss of lysine, arginine and histidine. Observed (Reichert & Young, 1977). Aleurone and germ are the main contributors of protein in bulrush millet (Hulse et al. 1980). Lysine, arginine and histidine in bulrush millet are mainly located in the germ (Nwasike, Mertz, Piekett, Glover, Chiber & Van Scoyok, 1979). Of much concern again, is the loss of lysine (a limiting amino acid in bulrush millet) which occurs during dehulling as indicated above, resulting in the lower protein value in the dehulled flour.

Minerals

Results for mineral composition is presented in Table 3. Except for calcium (Ca) and zinc (Zn), there was a slight increase in mineral content after 48 hours germination. Magnesium increased by 7 percent phosphorous by 6 percent, and iron (Fe) by 3 percent. A decrease by 11 percent and 4 percent in Ca and Zn respectively was also recorded. Prolonging germination up to 72 hours resulted in a substantial increase in Fe by 19 percent and Zn

by 12 percent. Dehulling caused a big loss of all minerals. Except for Fe, losses increased with high refining. At 80percent extraction, loss was by 19 percent in Mg, 18 percent in P, 26 percent in Zn, 44 percent in Ca and 24 percent in Fe. At 63 percent extraction, the average loss increased by 10 percent in all minerals except Fe. Bran had 2-4 times higher in Mg, PCa, and Fe.

There were variable differences among different mineral values obtained in this study and those published earlier for bulrush millet. The values for Ca, P and Fe recorded in this study in the washed ungerminated whole flour (Table 3) are within reported values 29-50mg/100g for Ca, and 269-391mg/100g for P, as reported by Desai and Zende, (1979) and 3.5-8.3mg/100g for Fe as reported by Varriano-Marston et al. & Hoseney, (1980). The value of Zn as reported by Kumar & Kapoor, (1983), Sankara Rao & Deosthale, (1983) and Varriano-Marston et al. (1980) are, however, lower (1.9-3.8mg/100g) than values obtained in this study (Table 3). Varietal and ecological differences mainly account for the differences. Ecological differences have also been reported by Szalay & Muranyi (1982).

Total dry matter loss as explained in the case of protein and fats, accounts for the increased minerals after germination. Contamination from the soaking media is, however, not overruled.

Leaching into the soaking media may partly be responsible for Ca loss observed. However, changes that occur during germination could possibly result in more Ca being concentrated in the rootlets and coleoptiles. Due to the brittleness of rootlets and coleoptiles, some of these may accidentally get lost during sample handling through detachment from the grain leading to loss of Ca more than other minerals.

Minerals in bulrush millet are concentrated in the germ and aleurone layer (Hulse et al. 1980). Removing these portions during dehulling leads to substantial loss of minerals. The higher content in the bran confirms this argument.

The high content of iron (6.2mg/100g) in the 63 percent extracted flour is unexpected and is probably due to contamination during dehulling. The high Fe content in the unwashed whole flour sample is due to the soil contamination. This indicates that a fair proportion of total Fe presented in foods as purchased is contributed by contamination Fe. The availability of contamination Fe from the soil remains controversial. Most reports, however, agree that this type of the Fe which apparently raises the amount of total Fe intake of diets in developing countries have a low availability (Hallberg & Rossander, 1984). This means that the Fe intake based on analysis of foods be overestimated.

CONCLUSION

The nutrient composition of bulrush millet variety used in this study was comparable to other common staple cereals used in Tanzania. Germination was more useful in improving nutritional quality especially of the protein quality. The increased lysine chemical score indicates improved protein bio-utility. The high losses of lysine (the most limiting amino acid in cereals) in the highly refined flours results in poor protein quality and thus bio- utility. It is recommended that use of germinated flour be promoted for child feeding.

Table 1: Proximate Analysis, Phytic Acid (PA), Tannin (T) & Dietary Fibre (DF) on Dry Weight

	Crude (%)			
	Protein	**Fat**	**Ash**	**DF**
Whole flour				
• Ungerminated	13.6	6.2	1.5	6.3
• 48 hrs germination	14.0	5.3	1.4	7.8
• 72 hrs germination	14.5	5.7	-	7.8
Dehuled flour				
• 80% extraction	12.3	4.3	1.1	4.2
• 63% extraction	12.2	4.2	1.0	3.6
• Bran fraction	16.8	13.4	3.5	12.8

a) mean of duplicate
b) bran from 80% extraction flour

Table 2: Amino acid composition and chemical scores[a] g/16 Nitrogen on dry weight[b].

	Whole flours			Extraction rate	
	Ungermi-nated	Germinated (hrs)		80%	63%
		48	72		
Lysine	2.9(35)	3.4(62)	4.0(74)	2.6(48)	2.0(36)
histidine	2.6	2.3	2.5	2.4	2.0
arginine	4.4	4.3	3.9	3.9	3.2
asparticacid	8.2	8.7	9.4	7.5	7.1
threonine	3.7(92)	3.6(90)	3.7(93)	3.5(89)	3.6(89)
serine	4.1	4.0	4.0	4.2	4.3
glutamic acid	19.1	17.7	16.8	18.6	21.1
proline	6.8	6.6	5.4	7.7	7.7
glycine	3.5	3.4	3.6	2.7	2.5
alanine	8.0	7.5	7.5	8.5	8.3
valine	5.6(116)	5.6(114)	5.6(115)	5.7(114)	5.5(112)
methionine	1.5	1.4	1.6	1.5	1.7
isoleucine	4.3(109)	4.2(105)	4.3(107)	4.4(110)	4.5(112)
leucine	10.5(150)	9.5(134)	9.2(131)	10.8(153)	11.2(159)
tyrosine	3.2	3.4	3.0	2.9	2.6
phnylalanine	5.3(140)	5.1(121)	5.2(118)	5.4(137)	5.3(131)

a) % chemical scores. Values in parenthesis are chemical scores calculated according to FAO/WHO (1973) provisional scoring pattern.

b) Mineral composition on dry weight (mg/100g sample)[a]

Table 3: Mineral composition on dry weight (mg/100g sample)[a]

	Mg	Ca	Fe	Zn	P
Ungerminated whole flour					
. Unwashed grain	-	-	13.6	5..2	-
. Wasahed grain	115	28	6.2	5.0	276
Germinated whole flour					
. 48 hrs germination	123	26	6.4	4.8	292
. 72 hrs germination	-	-	7.4	5.6	-
Dehulled ungerminated flour					
. 80% extraction	93.9	16.5	4.7	3.7	7.3
. 63% etraction	78.1	9.9	6.2	-	193.7
. Bran fraction	262.2	111.2	21.9	-	678.6

b) mean of duplicates

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FACILITATING PARTNERSHIPS OF FOOD INDUSTRY, GOVERNMENT AND SCIENCE FOR NATIONAL ELIMINATION OF MICRONUTRIENT MALNUTRITION

Frits van der Haar
Opportunities for Micronutrient Interventions (OMNI) Project

1. Introduction

The world-wide elimination of micronutrient malnutrition will be the greatest public health achievement of this decade. At the World Summit for Children in New York, 1990, Heads of State and Government pledged their commitment to a series of prominent goals for the present decade, including the elimination of the worst forms of hunger and malnutrition.

The nutrition goals have been re-confirmed in the World Declaration on Nutrition, formulated and adopted by more than 1,300 delegates from 159 nations at the International Conference on Nutrition in Rome, 1992. The specific goals for micronutrients agreed at these top gatherings were: the virtual elimination of iodine and vitamin A deficiency disorders, and the one-third reduction of 1990 levels of iron deficiency anaemia in women of reproductive age.

Reports issued by UNICEF and FAO/WHO from these meetings summarise the extraordinary commitment made by the entire development community. The reports include also the Action Plans that were adopted as guidelines for achieving the goals. The Plan of Action for the Survival, Protection and Development of Children (New York, 1990), and the Plan of Action on Nutrition (Rome, 1992), spell out in detail the implementation strategy for giving children a better future and ridding the world from hunger and malnutrition, problems that persisted up to the 1990s despite the existence of the knowledge and the resources needed for their solution.

II. Partnerships Required For Effective Action

When implementing national programmes aiming at realising these goals, governments take the leading and coordinating role. To attain quick and sustained progress, however, governments depend on the participation by others for concetreted action: non-governmental agencies (including consumer organisations), local communities and their representatives, academic staff of universities and research institutes, the private sector (including food industry), and international agencies. The gathering of nutritionists with food scientists, technologists and other practitioners from the agriculture and food sector at the ECSAFoST Food Conference in Victoria Falls, Zimbabwe, September 1994, offered a unique opportunity to consider the general role of food scientists and technologists, and of food industry in particular, in accelerating global process to the elimination of malnutrition.

III. Building The Partnership

One aspect that has received relatively little attention in the time since the two important global meetings is the accomplishment collaborative linkages between government officials and industry representatives and scientists directly involved with the food manufacturing sector. It would seem that in an understandable eagerness to follow-up on the global commitment and address the ensuring national responsibilities, most of the efforts and activities in these countries have been confined to the circles of the government and food and nutrition sciences. Relatively, little effort has been directed to the questions of how to mobilise effectively the agriculture and food sector that has, as its basic objective, the very thing that should have been achieved: improvement of access to nutritionally adequate foods that constitute the common, national diet.

IV. Major Principles

For obtaining more clarity on the role of the agriculture and food sector, the relevant sections of the two Action Plans should be reviewed. In summary, they dictate the following policy principles for enhancing progress:

- Enough is known of the nature, magnitude and causes of hunger and malnutrition problems. Their alleviation is urgent. The resources needed for addressing the worst forms of hunger and

[1] *Report of a Round Table Discussion at the Satellite Symposium on Micronutrients held during the ECSAFoST Food Conference 94 on Food Science and Technology - Challenges for Africa towards the Year 2000; Victoria Falls, Zimbabwe, 12 - 16 September, 1994.*

[2] *This work was made possible through support provided by the Child Survival Division, Global Bureau for Population, Health and Nutrition, US. Agency for International Development, under the terms of Contract No. HRN-5122-C-00-3025-00. The opinions expressed here in are those of the author(s) and do not necessarily reflect the views of the US. Agency for International Development*

malnutrition, including micronutrient malnutrition, are available;

- Leadership of national programmes rests with government. However, participation in programmes by other sectors of society is essential for achieving the goals by the year 2000;
- Provision of an appropriate diet by improved access to a variety of nutritionally adequate and safe foods is of eminent importance. It can be realised by unleashing the private infrastructure that addresses nutritional objectives;
- The agriculture and food sector is uniquely positioned to address poverty as a major underlying cause of hunger and malnutrition, as well as to provide food, employment and income; and
- Research in food and nutritional sciences, where appropriate, should give priority to the ways and means of improving nutritional well-being by developing effective interventions.

These principles, in their turn, suggest the need for a significant departure from previous practices of nutrition programming and research. Firstly, they indicate that a major mobilisation effort should be directed towards the agriculture and food sector which possesses the knowledge, skills and technology to improve broad-scale access to a nutritionally adequate and safe diet. Secondly, to achieve the nutrition goals on time, the talents of this sector should be applied with priority towards generating income, employment and food for alleviating poverty as major underlying causes of hunger and malnutrition. Thirdly, the expertise of private food industry should be harnessed to contribute to solutions of nutritional problems and poverty.

V. Application to Micro-Nutrient Problems in ECSA

In many areas of the world, including the East, Central and Southern Africa (ECSA) region, the significant problems of micronutrient malnutrition have been reviewed at several occasions (see Siandwazi, 1994, for the latest ECSA inventory). There always remains more detailed survery work to be done, but it can be accepted that, by and large, the nature, extent and causation of micronutrient problems are known in ECSA countries. Also, the major strategies towards the solution of these problems are available and the status of their application, as part of national strategies, have been subject of reviews at the same gatherings. We further feel confident that when solutions are applied effectively and at a sufficient scale, they provide extraordinary benefits to the population, to the nutritional well - being, health, educability and productivity of the people, and to the national economy. We also concede that the knowledge, skills and technology to provide solutions, and the finance required for their application are within reach.

When, however, it comes to mobilising and applying these resources, we seem to fall short of effective efforts in attempting to harness them for the purposes of addressing poverty and achieving the nutrition goals. We don't seem to be able to utilise the talents of our partner nationals who are the owners of the ways and means to make food-based solutions happen - partners in the private sector, the food industry and agriculture and food science, shortly "food science and technology."

VI. Application to the Discussion

The objective of the "round table discussion at the ECSAFoST Conference was to promote intensification of a dialogue among food industry, government, international agencies and the scientific community to eliminate micronutrient malnutrition. For the food industry, the goals and declarations of New York and Rome provide a unique opportunity to take the lead in a major public health issue that can be solved with the knowledge, technology and skill they have available. The round table would provide initial directions for similar dialogues that can take place in member countries of the participants after their return home.

VII. Results of the Discussion

The following is a summary of the reactions that were voiced during the discussion of the three major questions posed. These reactions presented the opinions of only the group of delegates present at the discussion, not those of the entire conference.

1. What incentives are needed and available to involve private food industry in a partnership with government and scientists?
   - Food industry would derive a positive product or corporate image from participation in the partnership;
   - Food industry would require relaxation of regulations that are prohibitive to the development of better quality foods, for instance, regulations against fortification of certain foods;
   - In countries with a larger number of

fragmented food industries, a representation by a food manufacturer's association should be attempted;

- Government and scientists, in collaboration with food industry, should develop a testimonial for those food manufacturers that comply with products and practices that promote nutritional well-being.

2. How can food industry become a leader in the partnership?
   - Food industry would require the acceptance by the other partners in the partnership of their basic operational principles, namely the making of profit for investment;
   - In order to assure fair manufacturing practices, food industry insists on "equal treatment of all", irrespective of the size or scale of their manufacturing operations;
   - Recognition by the other partner for food manufacturers with a proven record of "social responsibility";
   - Refraining by food industry from unreasonable demands for subsidy on high quality foods, connected to refraining by government from unrealistic price controls;
   - To protect bona fide manufacturers, controls are required by adequate and effective food legislation, including the fair application of enforcement.

3. How can the partnership be facilitated in the region?
   - In ECSA, as in Sub-Sahara Africa generally, the relationship of food manufacturing with agricultural production is strong and more directed than in other regions of the globe. Thus, the greatest penetration into the most affected population is only achieved by putting emphasis on technologies and systems applicable to small - scale agricultural enterprises;
     In many countries of the region, agricultural development research institutes, food science and technology development centres, nutrition institutes and some health or management research institutes have knowledge, skills and /or technology available which can be used for projects by the partnership;
   - The dominant leading principle for noval food development in food manufacturing enterprises of the region needs shifting away from " production of minimum cost" towards "production for optimum nutritional and safety quality".

VIII. Conclussion

The round table concluded with the following recommendation to the ECSAFoST conference delegates which was presented, discussed and accepted at the plenary closing meeting:

"Each country of the ECSA region should make a special effort to form a Partnership of Food Industry, Government and Science, supported by the international development agencies, for the elimination of micronutrient malnutrition. Detailed mechanisms for the establishment and operation of the Partnership should be worked out by individual countries".

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ONE DAY SELF REPORTED DIETARY SURVEY AND ITS LIMITATIONS: A CASE STUDY

Dr. A.B. Sanga
London School of Hygiene and Tropical Medicine

Abstract

Self reported food intake and energy expenditure survey was done by 24 Postgraduate Nutrition students, using weighed and 24 hours recall methods for intake and diary activity for expenditure. The group energy expenditure (2168.5 kcal) was higher than intake by both weighing (1884.3 kcal) and recall (1846.1 kcal) methods.

There was weak correlation between weighed intake and energy expenditure ($r = 0.31$, $p<0.02>0.01$) but there was no correlation between recall intake and expenditure ($r = 0.03$, $p> 0.05$). Energy expenditure in females (2139.1 kcal) was higher than their intake by both weighing (1819.1 kcal) and recall (1817.9 kcal) methods. Male had a higher weighed intake (2601.5) than expenditure but the recall intake (2160.0) was lower than the expenditure. Energy intake for females was lower than the FAO/ WHO recommended value. Males energy intake (2601.5 kcal) for their average weight and age was slightly higher than FAO/WHO recommendations.

The female, male and group energy expenditure were within FAO/WHO recommendations. However, due to small sample size (two) male results are not valid for comparison. A single day's dietary survey does not present the usual intake or expenditure of an individual, because of a large deviation from true value following day to day variation. Self reported dietary intake tends to be lower compared to energy expenditure. The methods used in assessing intakes and expenditure each has its errors and limitations which are discussed in the text. A good correlation between energy intake and expenditure cannot be determined in a one day assessment.

Abbreviations

EI	-Energy Intake
EE	- Energy Expenditure
TEE	- Total Energy Expenditure
FAO	- Food and Agricultural Organisation
WHO	- World Health Organisation
BMR	- Basal Metabolic Rate
PAR	- Physical Activity Ratio
PAL	- Physical Activity Level

Introduction

The aim of dietary surveys whether made on individuals or on groups is to discover what the persons under study are in the habit of eating. Dietary surveys are also important in estimating adequacy of the dietary intake and energy requirement of an individual.

The results of dietary survey, whether limited in size or national in scope, constitute data that strongly influences the accuracy of many important conclusions relating to nutritional status or to risk for certain diseases in population or their sub groups. Generally, dietary intake assessment methods fall into two categories:methods based on memory (recall, diet history) and those based on records of food eaten at the time of consumption. Up to now no reference dietary assessment method has been devised so the approach of relative validation is widely used to compare different methods[2]

Several studies have compared self-reported dietary energy intake with energy expenditure measured by doubly-labelled water method in free living subjects, and most of these have demonstrated poor correspondence between energy intake and energy expenditure. A 24 hours food intake and energy expenditure study was undertaken by Postgraduate Human Nutrition students.

The objectives of the study were:-

1. To compare food intake by weighed food record and 24 hours recall methods, their advantages and limitations;
2. To establish the accuracy of results and limitations in a self-reported one day dietary survey; and
3. To validate energy results against expenditure.

Literature Review

A single day's dietary intake does not represent the usual intake of every individual. According to FAO/ WHO report [1] a given individual's requirements may vary overtime, but this will be negligible relative to variation between individuals[3]. When the daily variation within subjects is large compared to variation between subjects there will be a

misclassification effect in ranking individuals on basis of their intake[2].

In study conducted in Canada, intakes were measured for one day on six occasions in a year. The total variability was about 35 percent and the variabilty both within and between subjects was about 25 percent [4]. Generally, dietary surveys of short duration are associated with a very large deviation of findings from the true value. With a one day survey deviation can be 32 percent and 64 percent for individals characterised respectively by a low and high variability of their day to day eating behaviour[5]. Prolonging the dietary survey to seven days improves significantly the deviation from the true mean.

Literature indicates that there is a lag between energy expenditure and energy intake, but the duration of the lag is variable both between individuals and in the same individuals [6] This implies that, energy imbalance may exist under normal every day life over periods extending up to 5-7 days. Several dietary surveys, have shown that a positive energy balance can be achieved over periods longer than seven days[7].

The 24 hour recall method is less accurate than the weighing method, since it mainly depends on the subjects ability and honesty in remembering and describing the intake, and on the interviewer's skill in quantifying these descriptions.

A 24 hour recall method tends to give lower estimates of intake compared with weighed food record method, as it is in this study (Figure 1). The overall average intake may be underestimated by as much as 21 percent.[8] However, most studies in adult subjects that have used doubly labelled water estimates of Total Energy Expenditure (TEE) for evaluating the accuracy of self reported energy intakes by weighed food record have suggested that in obese and randomly selected groups the weighed food record method is biased to underestimation of habitual energy intake than has been appreciated[9]

FAO/WHO have set recommended daily energy requirements according to Basal Metabolic Rate (BMR) and Physical Activity Level (PAL), but these are not easily determined for individuals, they are generally applied to groups. Assuming that requirements are distributed normally in a population, the recommended intake is then the average requirement of individuals in the group.

Methods

Subjects

Twenty four Postgraduate Human Nutrition students (22 females and 2 males) participated in the survey, they were aged between 20 and 40 years and weighed between 44 and 71kg. Weighing was with no shoes and minimum clothes.

Experimental procedure

Weighed food record method

Each subject had to record all foods consumed over 24 hour period, with the corresponding weight (in kg) which were determined by digital electronic balance to one decimal point. Foods were weighed before and after cooking (where possible) and the weight of plate waste was deducted. All fluids with nutritive value were also weighed using the balance.

24 Hour recall method

On the following day, working in pairs a dietary history of previous day's food intake was taken. Food portions size were described using house hold measurements and hands. The descriptions for food portions size and volumes were converted into weights (using food portion tables) and analysed for nutrient value.

Energy expenditure

Acomplete timed activity study was maintained throughout the 24 hour period, beginning at midnight to midnight. Activities were recorded in five minutes periods and the time spent on each activity was totalled to account for all the 1440 minutes in a day.

Data analysis

Food both weighing and recall methods the nutritive value of each food/fluid was calculated from food composition tables (10), sometimes manufacturers nutritional information (for packed foods) was used. All the values were then added to obtain total energy intake for 24 hour period. The total energy expenditure was computed by multplying the time spent on each activity over the day by its energy cost from the Physical Activity Ratio (PAR) tables(11). BMR was calculated from the equation given(1) using body weight. Paired t-tests were done to determine the signficance of differences between weighed food intake and 24 hours recall methods and the difference between the energy intake and expenditure for the group.

The EPI-INFO programme was used to determine the correlation coefficient and linear regression between the different variables.

Limitations

A few limitations were encountered in calculating the energy intake and expenditure, these included:

1. Food tables and data bases were limited in their content so food approximating to that actually consumed had to be chosen from the list in order to obtain energy intake.

2. The PAR tables had limited activities such as that to calculate the energy expenditure of some activities the PAR of closely related activities had to be used.

Results

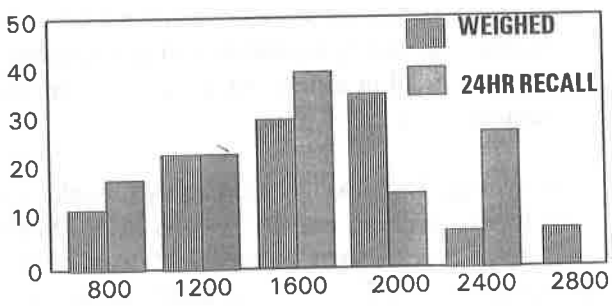
Table 1: The avarage values and standard deviation of the study variables for males and the group

Varlables	Males n = 2	Females n = 22	Group n = 24
Energy intake (Weighed Kcal)	2601.5+601.7	1819.1+405.4	1884.4+463.2
Energy intake (Recall) kcal	2160.0+403	1817.9+451	1846.1+448.9
Energy Expenditurekcal	2492+84.4	2139.1+196	2168.5+213.3
Energy expenditure BMR(PAR)	1.5+0.05	1.6+0.11	1.6+0.11
BMR	1679	1331.1	1360.1
BWT	66.3	56.7	57.5

The regression line equation for intake against expenditure is y = 432.96 + 0.67 x (kcal)

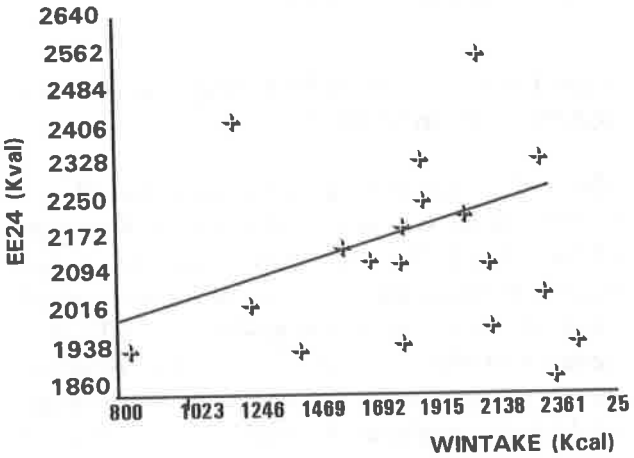
The main values for males are statistically not significant because of the small sample size, therefore, comparison between the two sex will be invalid.

Figure I: Frequency distribution of energy intake by weighed and 24hr recall methods



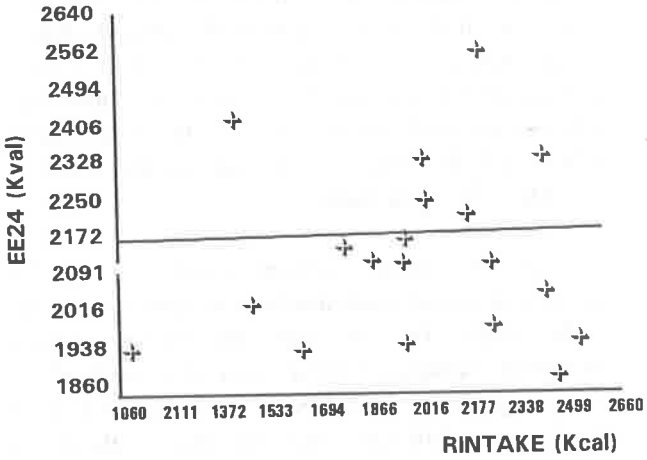
Energy intake by weighed food record is skewed to the left, with majority of the subjects having intakes between 2000 and 2399 kcal. With an average of 1884.3. For the 24 hour recall, the intakes are normally distributed with peak intake being between 1600 and 1999 kcal. The maximum intake with weighed food record was 3027 kcal while for 24hr recall it was 2657 kcal. basing on these results it is likely that there was under reporting of intakes with 24 hr recall compared to weighed food record.

Fig. II: A one day relationship between energy intake (EI) by weighed food record and energy expenditure (EE) for a group of Postgraduate nutrition students. (n = 24, r = 0.31, y = 432.96 + 0.67 x p < 0.02 > 0.01)



There were very few subjects whose EI and EE were related, otherwise the association between EI and EE was weak (r = 0.31).

Fig. III: Relationship between a one day energy intake (24hr recall) and energy expenditure of a group of Postgraduate nutrition students (n = 24, r = 0.03, p> 0.05).



The EI and EE of the subjects are widely scattered and there is no correlation between them (r = 0.03). The two scatter grams (figure II & III) indicate the difference between weighed food record and 24 hr recall methods in assessing energy intake.

Discussion

A healthy adult who is engaged in similar activities from day to day and is maintaining body weight, will have nearly constant requirements equal to her/ his habitual intake. (Children, pregnant and lactating women will need additional calories to ensure satisfactory growth or function) . If energy intake is consistently above or below a person's requirement, a change in energy body stores can be expected. In a negative energy balance active tissue mass is broken down to provide the body tissues with energy and in a positive state energy is stored as adipose tissue.

Thus Energy Intake (EI)=Energy Expenditure (EE)+Change in Body Weight

The average group value for energy expenditure (2168.5 kcal) was higher than the intake value (1884.3 kcal). This suggests a negative energy balance for the group and statistical analysis (paired t-test, p = 0.01. df 46) indicates true difference between intake and expenditure . The negative energy balance which can be due to underrating, could still be explained by a single day survey and inaccuracies and limitations in the method used to estimate energy intake and expenditure.

Figure II is a scatter diagram based on a one day intake and expenditure survey for the group. There is weak correlation (r = 0.31, y = 432.96 +0.69 x, p<0.02> 0/01) between the two variables. A good correlation cannot be determined from one day assessment due to inter and intra individual and daily variations. Good agreement between energy intake and expenditure has been found in studies continued for periods of six days (6). However, prolongation of surveys has its inconveniences which include logistic, cost, acceptability and co-operation from the subjects.

The 24 hour recall method is not suitable for assessing usual food and/or nutrient intakes of individuals. In this study the energy intake difference between weighing and recall method for the group was 38.2 kcal. Statistical analysis (t-test) on the mean difference gave a p value of above 0.5 indicating true group difference in results between the two methods. However, there was no significant difference (t-test, p < 0.01) between the two methods for females energy intake. Figure III is a scatter diagram trying to correlate the intake data 24 hour recall method and the expenditure. The data is widely scattered and there is no correlation (r = 0.03, p< 0.05) or no liner relationship. Studies comparing self reported dietary intake with energy expenditure measured by doubly labelled water method, have demonstrated that self reported energy intake tends to be lower than energy expenditure.

Low records of energy intake could arise from:

- A simple failure to record everything eaten;
- Conscious or sub-conscious under reporting, it is speculated that the subject tends to report intakes that are similar to the expectations for the population rather than to actual intake;
- Modification of eating pattern;
- The statistical uncertainty arising from the high level of day to day variability in human food[12]

The degree of deviation reported from real intakes is proportional to the degree of attention focused on the intake. Thus the results for energy intake could have been influenced by these factors. The energy intake for group (1884.3 kcal + 403.2) and for females (1819.1 kcal + 405.4) on one day probably gives a good estimate of their habitual intake as a group, but not for an individual.

Total energy expenditure (TEE) for adults is determined by energy needed for maintenance (BMR 65-70%), energy for physical activity (10-15%) and a relative small amount due to dietary induced thermogenesis. These factors are affected by several other factors including age, sex, body size and composition, and physical conditions e.g pregnancy, illness.

It is more difficult to measure energy expenditure than energy intake, but when measured accurately the variation within and between individuals is less compared to energy intake[4]. There are many methods available for the measurement of energy expenditure of different activities. Doubly labelled water is considered to be more accurate in determining Total Energy Expenditure (TEE). This method is based on observations that, after giving a loading dose of water labelled with ^{2}H and ^{18}O, ^{2}H is eliminated as water whereas ^{18}O is eliminated as water and carbon dioxide. The difference between the elimination rates is, therefore, a measure of carbon dioxide production, which along with an estimate of the respiratory quotient, provided a measure of TEE.

The activity pattern of one day should not be taken as the habitual energy expenditure of an individual, but may be used in estimating the average energy expenditure of a large group.

The average body weight and energy intake for females in this group was 56.7kg and 1819.1 kcal+ 405 respectively, their mean BMR was 1331.1 which gives a PAL of 1.37 x BMR. It has been

suggested that intakes which are less than 1.4 times BMR are probably inaccurate unless they are accompanied by weight loss or severe reductions in physical activity (13).

The average weight for the two males in the group was 66.3kg with mean intake of 2601.6kcla + 601.7 and PAL of 1.5 x BMR. Because of the small sample size these results are statistically not valid for comparison.

Waterlow(4) had documented that it would be possible to maintain life on energy intake of about 1.2 x BMR, but only if all services are provided. The realistic maintenance requirement would be 1.4 x BMR, this will allow for light activities e.g. cooking or walking about.

Energy expenditure for the group was 2168.5 kcal + 213.3. The average value for males was 2492 +84.8 and the PAL was 1.5 x BMR. According to FAO/WHO (for age range 30 - 60 and average weight 66kg) their energy expenditure will be between 2300 and 2600 kcal, but this comparison is not valid because of the insignificance of the male results. The FAO/WHO recommend energy expenditure, for female aged 18 to 30 and weighing between 55 and 59 kg with PAL of 1.6 to be 2100 kcal(1). The average energy expenditure for females in the group was 2139.1 kcal + 196, this value agrees with the FAO/WHO value for age, weight and PAL.

CONCLUSION

Generally, a weighed food record for one day or a 24 hours recall provides estimates of the average habitual intake for most nutrients for a large group but not for individuals.

Self reported dietary intake tends to be under reported, this is most probably conscious or sub conscious. No method of dietary assessments likely to be immune to misrepresentation of food intakes by weight concerned subjects. The 24 hour recall gives lower estimates of intake when compared with weighed food record, this has also been demonstrated in this study.

There is a lag between energy expenditure and intake, energy imbalance may exist under normal every day life over periods extending up to seven days, thus there will not necessarily be a correlation between intake and expenditure measured on the same day.

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POWER 'FLOUR' AND ITS USE IN TANZANIA

A review

S. Kimboka
Tanzania Food and Nutrition Centre

Abstract

Child malnutrition in Tanzania is a serious problem. It affects about 52 percent of children under five years of age, of whom 5 percent are affected severely. The problem starts mainly during the weaning period. The local weaning foods are starch staples which, due to traditional ways of preparation, do not provide enough energy to meet child's requirement.

Porridges need to be thick if they are to be of high energy density. But the high viscosity makes it difficult for young children to eat satisfactorily. The challenge then is how to achieve a diet of high energy density and low consistency.

The amylase-rich flour referred to as 'power flour' has dietary bulk-reducing properties. It is obtained from malted grain and heightened starch degrading enzymatic activity capable of thinning down viscous gruels while their high energy densities are maintained. Thus by adding this flour to a porridge young children can consume high energy gruels with ease and satisfy their energy requirements.

Promotion of the use of 'power flour' has been attempted in some parts of Tanzania but its adoption has been poor for various reasons including cultural unacceptability and ignorance. A significant rise in the level of acceptance was realised in one community which had been adequately sensitised on the preparation and use of the flour.

It is concluded that wide promotion of 'power flour' is feasible through teaching demonstrations at the community level. Pilot trials could be conducted to gather more concerning cultural acceptability, safety and cost-effectiveness of the flour and thus to pre-test the feasibility of its promotion nation-wide.

INTRODUCTION

Infant and young child feeding practices have a direct link to the level of child malnutrition, morbidity, and mortality. In Tanzania child malnutrition is a serious problem. Tanzania Food and Nutrition Centre (TFNC) ranks Protein-Energy Malnutrition (PEM) the first among the four major nutrition problems in the country, others being Nutritional Anaemia, Iodine Deficiency, and Vitamin A Deficiency. The spectrum of malnutrition varies from underweight to the severe forms-marasmus, kwashiokor, and marasmic-kwashiorkor. On average 52 percentage of children under five years of age are affected, of whom 5 percentage suffer the severe forms.

The fatality rate of the severely undernourished children is very high, reported as being 30 percentage or higher in some hospital(1). It is further observed that many more severely undernourished children never reach the health facility for special treatment, thus dying within a few weeks'. From this, it is concluded that, the prevalence rate of severe malnutrition may be oscillating between 5 percent and 10 percent.

Malnutrition in children starts mainly during the weaning period. For, while breast milk may be a sufficient source of energy and other nutrients during the first four to six mouths of life, it is, thereafter, insufficient by itself to support the growing infant. The energy-gap that opens up must be filled, hence the introduction of other foods. If the weaning food is of very low energy density, the intake falls short of the child's requirement and malnutrition results. Such is the case with the starchy staples which make up most of the traditional weaning foods in Tanzania.

The energy insufficiency of the foods finds its explanation in the chemical and physical properties of starch. On heating , starch binds water and swells into a voluminous viscous gel. A starch gruel of satisfactory high energy density becomes too viscous for a young child to eat. If diluted with water the density becomes too low to meet child's energy requirement.

Amylase-rich flour, referred to as 'Power Flour', is obtained from malted grain. It is characterised by high enzymatic activity capable of liquefying thick (high energy density) gruels. The thin gruels that result (the high energy density being maintained) can thus be easily consumed by a young child and satisfy its energy requirement.

The purpose of this review is to look into the biochemical basis of 'Power Flour' as related to the improvement of energy densities of the traditional weaning foods. Also a wide promotion of its use as a long term intervention against child malnutrition in Tanzania is recommended.

TRADITIONAL WEANING FOODS AND CHILD MALNUTRITION

The Energy Basis of the Foods

Most of the weaning foods in Tanzania, owing to the traditional ways of operation, would not satisfy the energy needs of the child. They are typically watery gruels based on starchy products: cereals like maize, sorghum, millet, wheat and rice; or tubers and roots like potato and cassava. Plantains are also used by some communities.

When starch granules are heated in water they swell and gelatinise, forming a voluminous water retaining paste on cooking[2]. The 'high volume high viscosity' characteristic of diet is referred to as 'dietary bulk'[3].

Such thick feeds are difficult for young children to eat satisfactorily. Dilution with water brings about the desirable consistencies but the energy and other nutrient densities of the meals decline. Svanberg[3] found that to bring the food viscosity down to a level appropriate for a young child the flour concentration could come as far down as 5 percent which would give only 0.2 kcal per gram of the gruel. Too large volume per meal or too large number of meals per day would be needed to satisfy the child's energy requirement.

The Level of Energy Intake in Tanzania

Studies on food intake in Tanzania[5] show that children under four years are able to eat up to 400 grams of the thin gruel (*uji)* at one meal. For solid gruels such as *ugali* the figure is 200 grams. Energy requirements according to the WHO[6] for the 1-2 year old are 1200 kcal per day (boys) and 1140 kcal per day (girls). In order to meet energy needs a child of this age group, a boy for example, feeding on the 5 percent flour concentration gruel (0.2 kcal/g) would have to consume 1200/0.2 = 6000 grams of the thin gruel per day. With an intake of 400 grams of the thin gruel per meal the child would be compelled to eat 6000/400 = 15 times a day. But children can not consume 6000 grams of *uji* per day and they can not be fed 15 times. Indeed, Lukmanji(7), in a dietary survey of some four villages in Iringa, found that on average children were being fed only twice a day. Such low feeding frequencies are also cited in the Tanzania Government/UNICEF 1985 report(5).

Table 1: Average Food Intake (grams) in Young Children of Gruels of Different Dietary Bulks

	Four concentration in gruel		
Children's age (months)	5% (liquid)	20% (without P.F. - thick)	20% (with P.F. - liquefied)
5-12 (n=4)	154+ 77a	153+72a	163+106a
12-24 (n=8)	330+116a,b	277+93a	346+94b
24-48 (n=10)	491+201a	405+141b	445+172a
48-65 (n=10)	544+90a	517+107a	565+99a

Mean values within the same group followed by a different letter are signficantly different at P=0.05 (the Wilcoxon signed rank test)

Source: Reference(4).

The levels of energy intake, therefore, are indisputably low and that contributes to the high prevalence rates of child malnutrition.

Tackling the Problem of Low Energy Intake

A satisfactory energy intake can be in a number of ways:

- Resorting to commercial weaning foods: This option has been working in industrialised and other relatively wealthy countries. But commercial foods are costly and would be beyond the reach of the majority of the households in Tanzania.

- Addition of other food components like legumes, groundnuts, oil, milk, sugar etc.: These are highly suggested and needed but they are likely to be more of importance for protein and specific intakes than energy. Besides, they are not less 'rare commodities' for the majority of households than commercial foods are.

- Increasing the number of child feeds per day is important and should be insisted upon, but there are limits to the number of feeds a child can take. Furthermore, women are too bogged down by workload to be able to feed their children as many as 15 times a day!

- In this context, the use of power flour comes in as an alternative strategy against the problem of dietary bulk and child malnutrition.

'POWER FLOUR'

Definition

'Power flour' or *kimea* as is known locally is an amylase-rich flour obtained from germinated cereal grains.

The preparation involves soaking of the seeds in water, germinating, drying and milling. A description of the full process, as recommended by TFNC, is given in appendix 2.

The Significance of Grain Malting

Malting of grains has a remarkable effect on the viscosity of starchy gruels. Starch is a polysacchard, a glucose polymersynthesised by plants. The polymer consists of two components - long straight chains of glucose molecules (amlylase) and branched chains (amylopectin). The starch structure has a capacity to bind water and gelatinise. This makes it, when cooked, swell into a voluminous viscous gel(4;8-9;10).

Seeds consist largely of starch. They are also potential sources of the starch-degrading (amylolytic) enzymes i.e. alpha and beta amylases.

The two enzymes, acting in a complementary manner, effect breakdown of the complex starch molecules into simple carbohydrates - dextrins and maltose. The later have less water-binding capacity, do not gelatinise on cooking, and are more easily digested and absorbed(2;9)

Germination also brings about important changes in the composition of the seed contents: increase in the levels of some essential amino acids (lysine, threonine), vitamin C, riboflavin and niacin. Protein digestibility increases but, owing to a corresponding decrease in its bioavailability, it makes no impact on the Net Protein Utilisation. Levels of lectins and phyrates are decreased - with possible improvement in the mineral availability(2;11). Germinated grains acquire better shelf-life and more acceptable flavours(10).

The Bulk-Reducing Properties of 'Power Flour'

In the germination process starch hydrolysis takes place. The germinated flour, therefore, does not gelatinise or swell to the same extent as the non-germinated flour(12). This property enables large quantities of the 'power flour' to be used in the making of gruels - without the risk of running into the 'too high viscosity' effect. Svanberg(4) found that 'three time as much germinated flour can be mixed into the same volume of water while maintaining the same consistency of gruel".

Furthermore, germinated flour is characterised by enzymatic activity capable of liquefying thick (energy dense) gruels made from non-germinated flour. The thin gruels that result (the high energy density being maintained) can thus be easily consumed by a young child and satisfy its energy requirement.

The Intake of the Bulk-Reduced Foods

Products of germinated cereals have more acceptable flavours; their gruels are more liquid and, therefore, require relatively little effort to chew and swallow; they are more energy dense (high energy contents meals undergo gastric emptying more slowly (4), thus releasing adequate amounts of energy per unit time, for a longer time). Lastly, the amylolytic property of germinated flour is a great advantage to digestion.

The 'power flour' treated meals are thus more acceptable to the children: Mosha and Svanberg(13), reported that in Luganga village, children, especially those between one and four years, consumed thin gruels significantly more than they consumed thick ones.

Some Limiting Aspects of the 'Power Flour'

There is no doubt as to the efficacy of the 'power flour' in the strive to attain low viscosity gruels with high energy contents. However, these are limiting factors worth mentioning:

Safety: contamination with the aflatoxin-producing moulds and/or diarrhoea pathogens can affect any type of grain(10). TFNC has always acknowledged the problem of mould contamination in the malting of grains in Tanzania. The Centre does propose observance of the general rules of hygiene, through washing of the grain in clean water before and after soaking; as well as after the process of germination, before it is put to dry. Merero et al. (quoted in 10) proposes daily washing of the grain throughout the entire period of germination.

Sorghum, in particular, is found to contain a significant amount of hydrocynic acid (HCN) on germination. Data and Dendy(14) suggested that cyanide content could be eliminated by boiling the slurry or steaming the paste, and that 'power flour' should be added to the porridge at boiling point.

This suggestion, however, is countered by the findings of Mosha and Svanberg(8) that the

amylolytic enzymes start getting inactivated at a temperature above 70 degrees C. TFNC(12) advocates reboilling of the porridge after the addition and action of the 'power flour'.

Cost of Malting: malting consumes time, utensils and labour. It is 'another burden' on women who already have enough on themselves in terms of workload. Yet considering the beneficial effects of the use of the 'power flour' the cost of malting becomes a price worth paying.

Acceptability: since germinated products are known to have relatively more appealing flavours unacceptability is unlikely to be of organoleptic cause. Cultural acceptability seems to matter most. The evaluation about knowledge and use of 'power flour' in the Joint Nutrition Support Programme (JNSP) area, Iringa region, in 1988, revealed that only a small percentage of mothers had adopted it despite the advocacy of the flour that had taken place.

Tomkins et al[15] pointed out possible constraints which had led to the poor adoption of 'power flour': its association with the locally brewed beer, for, the latter is also made from germinated cereals; and improper teaching on the preparation and use of the flour. It is also cited that the mothers had not attached enough priority to child feeding, for, child illness and death were being linked more to malaria and diarrhoea than to anything else.

On the other hand the study by Mosha and Svanberg[12] showed encouraging results of acceptability. Demonstration on the preparation and use of 'power flour' had been carried out over a two month period and a subsequent valuation revealed a rise in the level of acceptance. For example, the proportion of those who used the flour almost every time weaning food was prepared' had increased from 13 percent to 28 percent. This speaks to the effect that, with efforts, cultural acceptance of the flour is possible in the communities of Tanzania.

CONCLUDING REMARKS

'Power flour' enables preparation of high energy density gruels the viscosities of which are low enough to be consumed by small children easily. It can be home - prepared and afforded by practically every household. Furthermore, the idea is not a new one among the majority of the people: cereals germination is commonly used in local brewing. It is an existing household technology which is finding its way into a more beneficial application.

A wide promotion of the use of 'power flour' in Tanzania is , therefore, a feasible undertaking. To be successful it needs high levels of awareness among the people, hence the need for advocacy, sensitisation and practical demonstrations on the preparation and use of the flour.

The example of Luganga village shows that there is room for community acceptance of the flour.

RECOMMENDATIONS

1. More information on 'power flour' should be sought in the areas of cultural acceptability, safety and cost - effectiveness in the Tanzania context:

2. To do that a pilot programme for the promotion of the use of the flour could be conducted in one district;

3. Such a programme should be a community-sustained intervention: the 'power flour being based on locally available cereals, home prepared and used as an additive to gruels made from ungerminated flour and targeted to children under five years of age;

4. The main strategies of the programme should be staff training, advocacy and teaching demonstrations at the community level. The existing infrastructure of MCH and VHW systems could be made use of;

5. Monitoring and evaluation should be based on the acceptance and use of the flour, side effects, costs in terms of materials and labour, and trends in the levels of child malnutrition; and

6. On the basis of positive results a nation-wide promotion of the use of 'power flour' could be recommended.

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THE 1991-92 DEMOGRAPHIC AND HEALTH SURVEY: IMPLICATIONS FOR NUTRITION IN TANZANIA

Ted Greiner

International Child Health Unit
Uppsala University,
Sweden

Abstract

The DHS survey of 1991/92 provides the first nationally representative data on health and fertility for Tanzania. Some 8 percent of women were chronically undernourished, contributing to the high prevalence of low birth weight (17 percent). Nearly half of the children under five years of age were nutritionally stunted (height for age <-2 SD). Nearly all of this nutritional damage was done during the first 18 months of age.

Breastfeeding was well established in Tanzania for this age group, but supplementation after six months may not be adequate. If women could be enabled to practice exclusive breastfeeding for the first six months, it is estimated that about half of this damage could be avoided. This would probably require information, education and communication (IEC), nutritional improvement for them and reduced work burdens. Research based on TFNC'S conceptual framework can provide additional guidance on the enormous work that lies ahead to solve this problem.

Key words: Tanzania, Nutrition, Infant Feeding,Nutrition Assessment

Introduction

Along with the Household Budget Survey done the same year, the Demographic and Health Survey (DHS) provides the first nationally representative data on nutrition and infant feeding for Tanzania. Its major focus was on fertility, family planning and health, but several variables relate to nutrition and will be reported on and discussed in this paper.

The DHS in Tanzania was conducted by the Bureau of Statistics in collaboration with the Ministry of Health, including the Tanzania Food and Nutrition Centre, with technical assistance from Macro International Inc., funded by the U.S.Agency for International Development. DHS studies have been done in many other developing countries since 1986, and are relatively similar in design to facilitate intercountry comparisons.

Methods

The interviewing was done from October, 1991 to March, 1992. The sample for the survey was intended to be representative for the whole country for women 15-49 and men 15-60.

A stage cluster sample design was used based on the 1988 population census list of enumeration areas. Interviews based on a series of partially standardised questionnaires were administered in 8,327 households. Of the eligible women (who had spent the night before the interview in a sampled household), 9,238 were interviewed, a 96 percent response rate. Men were interviewed in every fourth household, a total of 2,114 men, an 88 percent response rate among those chosen. Data were obtained on 7,171 children under five years of age.

While these sample sizes are large enough to produce excellent estimates of national rates, confidence intervals are such that comparisons among the regions should be made with care. As an example of the confidence intervals that result at national level, 47 percent of under-fives were found to be stunted nationally (<-2S)+2s places this estimate between 45 percent and 49 percent.

Findings

General

Some of the general but relevant findings, summarised for the whole of the country, including Zanzibar, included:

- 48 percent of women and 37 percent of men had no education (no data were obtained on literacy, however); 0.1 percent of women and 0.2 percent of men had some secondary or higher education.
- 47 percent of boys and girls (no gender difference) age 6-15 were enrolled in school.
- 82 percent of households used a traditional pit latrine and 14 percent had no sanitation facility 92 percent had no electricity;

- 33 percent of the women possessed a radio set but 46 percent listened weekly; 25 percent read a newspaper weekly; 22 percent possessed a bicycle;

- 47 percent of the women were married, 18 percent living together with a man, 3 percent widowed and 7 percent divorced; 28 percent of married women said their husbands had one or more other wives;

- The total fertility rate for women of 15-49 is 6.3 children per women and the ideal number of children desired is 6.1; education has little relationship to facility except for those few who attended secondary school but the number of children thought to be ideal declines with education;

- Medium age of women at first intercourse was 17 at first marriage was 18, and at first birth it was 19; all increased with increasing education;

- 72 percent of women were aware of modern contraceptive methods; 23 percent have at some time used one, and 10 percent were doing so currently: use rates correlate with level of education;

- 24 percent of married women want more birth spacing and 17 percent want no more children, but only 26 percent of this demand is currently met by family planning services;

- The infant mortality rate was 92 per thousand live births for recent births, 10-14 years ago it was 94; under-five mortality was 141 per thousand live births, a decline from 163; rates improve with education but are still 72 and 101 respectively for those who have attended secondary school;

- 96 percent of women attend some form of institutional health care and 72 percent had received two or more tetanus vaccinations; 53 percent delivered in a health facility; levels increased with education;

- 56 percent of children in their second year of life had complete vaccination coverage, 69 percent against measles, increasing with education of the mother.

- During the two weeks proceding the survey, 8 percent of under-five children had cough with rapid breathing, 1 percent had fever, and 13 percent had diarrhoea; 28 percent of these diarrhoea cases had not been given oral dehydration or other extra fluids.

Infant and young childfeeding

Breastfeeding was initiated for 97 percent children, and this was not related to any background variables. Only 43 percent received the breast within one hour of birth and 18 percent did not receive it at all during the first day of life. These rates were not affected by background factors, including place of delivery. Early initiation of breastfeeding was best in Zanzibar, where 61 percent received the breast within one hour and 97 percent within the first day and worst in Shinyanga with 26 percent and 65 percent respectively.

The medium duration of breastfeeding was 22 months but only one fourth of children 24-25 months old were breasfed. Duration of breastfeeding varied little with background factors such as sex of the child, assistance at delivery and place of delivery.

The longest duration was in Coast region, 25 months, and shortest was in Tanga, 16 months.

Exclusive breastfeeding (with no addition of solids or fluids, even water) is recommended for 4-6 months. However, the median length of exclusive breastfeeding in Tanzania was only 0.6 months. Even the duration of "predominant" breastfeeding (water included) was only 2.3 months. "Full" breastfeeding (water but no other supplement) decreased with increasing levels of education and were shorter in urban areas, especially Dar es Salaam, although the duration in Lindi (0.7 months) was equally low. The longest feeding occured in Shinyanga (5 months). Possibly late initiation of breastfeeding and later addition of other liquids are both more traditional practices and somehow such traditional practices have remained stronger in that region. Among infants under six months old, 93 percent received the breast six times or more the previous day.

Data were gathered on the foods and fluids given to underfives the day before the survey. (It should be kept in mind that these indicators thus under estimate the proportitions who receive these foods less often than daily). The proportion of children receiving supplementary infant formula differed by age, but, unlike in many other countries, was more common among older infants up to two years of age. At most ages, 10-15 percent received it. MI feeds were much more common, with 30-35 percent receiving them at most ages up to two years.

However, few mothers said these in MI feeds were given from the bottle: around 5 percent on the whole. The supplements given at 4-5 months of age probably unnecessarily in most cases, underestimate the incidence of wasting over a year's time. Severe stunting can be chronic and thus tends to get picked up better in this kind of survey.

When these data are examined at national level by age of the child, it appears that on average wasting is a problem mainly between the age of 10-26 months. Declines in height for age begin at birth and continue until the age of about 18 months where the mean stays constant below two standard deviations compared to the WHO reference population. That is, the average Tanzanian child aged 18-60 months is less than about 1-2 percent of children in well-nourished populations. However, no further nutritional damage takes place during that age period.

Weight for age reflects both wasting and stunting and is the only indicator commonly followed by the health care system or in community-based growth monotoring. It shows a rapid decline starting at about 15 months of age. Thus the average growth chart would show growth retardation occuring from 6-15 months of age. The average child will then follow the normal growth channel for weight achieved by age of 15 months.

Thus, on average in Tanzania, by 15-18 months of age the nutritionsl damage is done. The child is now more vulnerable to infections and may rapidly become severely malnourished at any time. Wasting shows up mainly at the ages of 3-36 months. Stunting reaches and maintains high levels from 12-59 months of age.

In the past, nutritionists focused their attention mainly on attained body size. Now there is a growing awareness that more important is the process of becoming malnourished. It is during this period, up to age of 15 months in Tanzania, that something can be done to prevent malnutrition, at least stunting. By six months of age, the average height for age of Tanzanian infant is already at -1CD.

If exclusive breastfeeding were practised until that age, very little of this damage would occur. Even if inadequate complementary foods and illness then began to take the toll the infants would have good nutritional stores to fall back on, and much of the severest malnutrition might never occur. Complementary feeding should, nevertheless, receive more attention.

Careful research is needed to find out what contraints are preventing mothers from exclusively breastfeeding for six months and from providing adequate complementary foods thereafter. Women may not be aware that breastmilk is all babies need during the first six months, they may lack the time, family and social support needed, household food availability may be inadequate, and malaria and other infections may be partly to blame for growth failure. As suggested by the TFNC conceptual framework, a complicated combination of these and other factors probably play a role in different ways in different groups of the population. In addition, stunting might be influenced by deficiencies in micronutrient such as zinc, about which little is known in Tanzania.

The DHS report shows that young child nutrition improves as the mother's education increases. Stunting is less common in Dar es Salaam but not wasting. The highest level of stunting and underweight are found in Mtwara and the worst wasting is in Tanga. Shinyanga has the lowest level of stunting, Dodoma has the least wasting, and Mara has the least underweight.

Community-based growth monitoring data from areas that have implemented Child Survival and Development Programmes usually suggest that levels of young child malnutrition decline in these areas. Sometimes public relations statements from such programmes create expectations that they should be greatly reducing malnutrition in entire regions, although only portions are actually covered, at least in the initial phases. This may explain why malnutrition is still at very high levels in Iringa, despite the widely praised Iringa Nutrition Programme (a point the DHS report (Bureau of Statistics and Macro International, 1993) expresses surprise about). Data like these remind us how difficult it is to have a substantial impact on undernutrition, perhaps the greatest health problem in the world. Even greater efforts will have to be made if Tanzanian government goals are to be achieved in the coming years.

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