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Small-scale production of weaning foods

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Small-scale production of weaning foods

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Foreword

This Agrodok booklet has been published by Agromisa Foundation. We hope that the information given in this booklet will help people in developing countries in preventing malnutrition among young children.

We are grateful for the support we got from Caritas Nederland in making this booklet. Sasja Kamil and Marianne van Lubek especially have added important improvements while the text was being written.

We thank the writers who managed to finish the text before they went abroad where they will work on putting this theory into practice. Also we would like to thank the people at Agromisa who put a lot of effort in finishing off the publication especially Floor Wolters, Marjoke van den Burg en Hetty van der Stoep who adapted the illustrations and Mechelle Meijboom and Ien Ko who got the tedious job to type and lay out the tables.

Agromisa welcomes readers of this publication to send us their comments and suggestions. Through your reactions we can assure that information given is as relevant as possible. This also enables knowledge to be shared among readers.

The publisher, 1997

Contents

1 Introduction

Malnutrition, mainly affecting children under five years of age, is a common problem in many developing countries. It is caused by different factors, such as:

- lack of food and a low quality of the food;
- lack of time to take care of children by parents and/or caretakers;
- lack of knowledge;
- poverty;
- lack of good quality health care resulting in the occurrence of many diseases.

In addition, inadequate and late supplementary feeding of young children is also an important factor. Breast-feeding is sufficient for most children in the first six months of life. Mother's milk contains all nutrients and sufficient energy children need up to that age.

After six months of breast feeding, supplementary feeding is essential because breast-milk alone cannot provide enough nutrients and energy for growing children. However, this supplementary feeding must be complemented with mother's milk and breast feeding should be continued for as long as possible; preferably up to two years of age.

The period when supplementary feeding is given, the weaning period, is the most critical period in the life of a young child. Malnutrition occurs mainly during this period, caused by: poor quality of the supplementary feeding and infrequent feeding so that the child does not get enough energy-giving and nutritious food.

In many countries young children are given porridge from rice or maize and water. This porridge often lacks the proper nutrients and energy for the growing child. Often, the person caring for the child lacks the time, money and know-how to prepare better infant food.

Several partners of Caritas Nederland in all parts of the world have had good experience with small-scale production of weaning foods

from locally available ingredients. These weaning foods are an excellent mixture rich in both energy and nutrients, inexpensive, easy to produce, quick to prepare and can be used by anyone, anywhere. It can be used for the prevention of malnutrition in young children, as well as for the treatment of undernourished children.

The small-scale production of weaning foods by itself is not the answer to the worldwide problem of malnutrition. The combination of setting up other activities, such as health and nutrition education, poverty alleviation with the production and sale of small-scale produced weaning foods could help to improve the situation regarding food and nutrition of young children.

We offer this book as a helping hand or guideline to groups or individuals who wish to produce weaning foods on a small-scale base with locally available ingredients or to persons who will guide others to do so.

Chapter 2 contains a general introduction on infant feeding. In Chapter 3 a few guidelines are given on how to arrive at a good weaning food formula, made clearer in Chapter 4 by means of a few sample recipes. Chapter 5 deals with the production process and preparation of weaning foods, and in Chapter 6, management, marketing and financial aspects of the production and sale of weaning foods are dealt with.

Figure 1: Supplementary feeding of a young child (Caribbean Food and Nutrition Institute)

2 Infant feeding

2.1 Introduction

Good, wholesome food is necessary for normal growth and development. All foods contain energy and various nutrients that are essential for optimal growth and development. Foods vary in composition of the necessary nutrients (see Appendix 1). Therefore, it is important that different foods are eaten, to be able to consume enough energy and nutrients (see Appendix 2). The most important nutrients are proteins, vitamin A, vitamin C, iron, iodine and calcium (see Appendix 3). The World Health Organization has drawn up the daily energy and nutrition requirements for children, dependent on age and weight (see figure 3). They are intended to be a guide for planning diets. Babies and young children grow fast and therefore need (per kilogram body weight) relatively large amounts of energy and nutrients.

Table 1: Daily requirements for energy, protein, fat, iron, iodine, and vitamins (Burgess, A. and King, F.S., 1993)

Age (years)	Weight (kg)	Energy (kcal)	Protein (g)	Fat (g)	Iron (mg) Diet H	Iron (mg) Diet M	Iron (mg) Diet L	Iodine (µg)	Vit.A (RE)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Folate (µg)	Vit.C (mg)
Children: both sexes														
0 - ½	5.4	585	10	-	-	-	-	-	350	-	-	-	19	20
½ - 1	8.8	960	14	-	7	11	21	50	350	0.3	0.5	5.4	32	20
1 - 3	11.9	1250	14	35	5	7	13	70	400	0.5	0.8	9	40	20
3 - 5	15.9	1510	18	42	5	7	14	90	400	0.7	1	10.5	53	20
5 - 7	19.6	1710	20	48	7	10	19	90	400	0.8	1.1	12.1	65	20
7 - 10	25.9	1880	26	52	8	12	23	120	400	0.9	1.3	14.5	85	20

* 1-3 years means 1 year 0 month to 2 years 11 months.

- No value available. Assumption made that breastmilk covers needs.

2.2 Switching over from breast-feeding to regular family meals

Breast-feeding

When a baby is born it is important that it drinks the first mother's milk. This is called the colostrum and is the first breast milk, produced in the first week of its life. This breast milk is yellow and sticky. It contains much protein and several other compounds that are essential for resistance to disease.

During its first 6 months of life, a young baby gets enough energy and nutrients from the mother's milk for optimal growth. Thereafter, supplementary feeding in addition to breast-feeding is of vital importance.

Weaning

Weaning is the process whereby the baby gradually becomes accustomed to a normal adult diet. This is a transition period for the infant from a diet of breast milk alone to regular family meals. It is generally advisable to start weaning at about six months. It is important to introduce supplementary feeding gradually, as the babies digestion needs time to get used to a different type of food. Do not stop breast-feeding abruptly.

Nurses and health workers use grow charts to check upon the growth of the baby. They measure weight, height and mid-upper arm circumference (MUAC) to assess the nutritional status of babies and young children. The weight taken of the child can then be compared with the WHO growth chart. Growth charts, shown in Appendix 4, can be a good guide as to when to start with supplementary feeding.

Figure 2: Weighing a baby

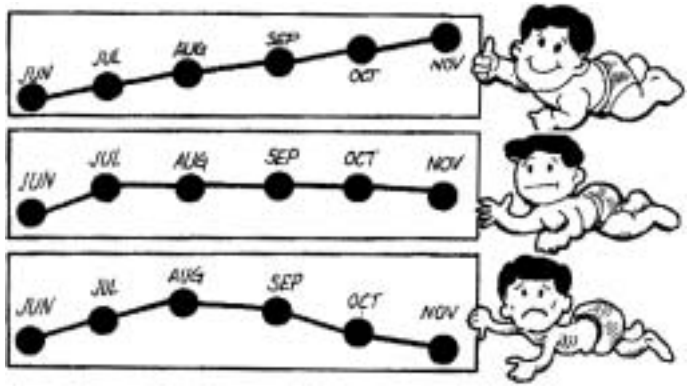

Figure 3: How to read a growth chart

As soon as growth begins to lag behind the optimum growth curve, it most probably means that the infant's energy and nutrient intake is inadequate. At this stage breast-feeding alone is no longer sufficient for optimal growth (see figure 3).

If weaning is started too late (certainly after 7 months) the infant's growth will be delayed and it will become underweight. Moreover, an older infant is less likely to be willing to try new flavours and other food. Consequently, the risk of malnutrition is increased if weaning is not begun on time. On the other hand, if weaning is started too early (under 3 months) it unnecessarily increases the risk of infectious disease, because supplementary feeding is less hygienic than mother's milk. In addition, the baby will suckle less resulting in an decrease of breast milk supply.

Weaning, therefore, can safely begin at about six months. From about 12 months the milk supply will gradually lessen. Breast-feeding can be stopped altogether somewhere between two and three years of age.

Gradually, the child will get used to the supplementary food. At first, the baby should be given one or two teaspoonfuls to taste, immediately after breast-feeding. It is better not to give the supplementary

food before breast-feeding as it may make the baby suckle less and this leads to a decrease in the quantity of breast milk. To begin with, supplementary food should be given once a day, starting with porridge. After the infant becomes accustomed to the porridge, other food such as mashed fruit or vegetables can be given. This is particularly important to raise the vitamin A and iron intake. Gradually the number of feeds of weaning food per day, quantity and variety of foods can be increased. At about one year of age a young child should get supplementary feeds four to five times a day, in addition to breast-feeding.

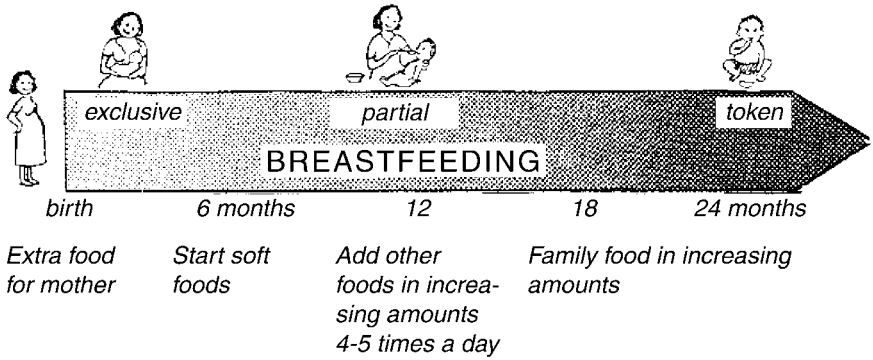

Figure 4: Transition of breast milk to family foods

Because a young child has a small stomach it is advisable to feed the child frequently. The stomach of a young child can digest 200-300 ml (1-1.5 teacups) at a time. Hence, for a child to be able to consume sufficient energy and other nutrients, it must be fed frequently.

From a practical point of view it is virtually impossible for women to feed their child so often, because they have far too little time to prepare food. The use of small-scale manufactured weaning food can be time-saving. The weaning food only needs to be well cooked and therefore is ready relatively quickly. This is how a mother with little time to spare can be helped to provide her baby with proper feeding. A good balance must be found between the time available to the mother and the number of feeds the child needs.

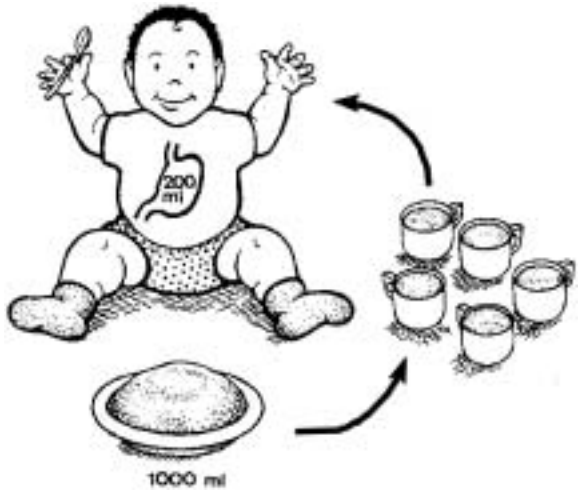

Figure 5: Young children have small stomachs and need to eat frequently (Burgess, A. and King, F.S., 1993)

2.3 The preparation of baby food in the home

Figure 6: The preparation of baby food in the home (Caribbean Food and Nutrition Institute)

To prepare the porridge three cups of water and one cup of weaning food are necessary. Bring the water to the boil and as it boils stir in the weaning food. Continue stirring until the mixture becomes smooth and then let it cook for a further 15 minutes. This porridge now contains sufficient energy and nutrients for supplementary feeding. Although not essential, sugar or oil may be added at this stage. It is important that the method of preparation is stated clearly on the weaning food packaging, and furthermore, that good instructions are given about the correct preparation.

Weaning and hygiene

The risk of infectious disease, especially diarrhoea, is greatest during the weaning period. This happens because the infant diet changes from the extremely hygienic mother's milk to supplementary food that can very easily get contaminated. It is therefore important that extra attention is paid to hygiene when preparing and storing the food. The hands, bowl, plate, spoon and other utensils must be washed thoroughly prior to preparing the porridge and feeding. Since the water used might be contaminated it should always be boiled first to kill all pathogens (such as bacteria and viruses).

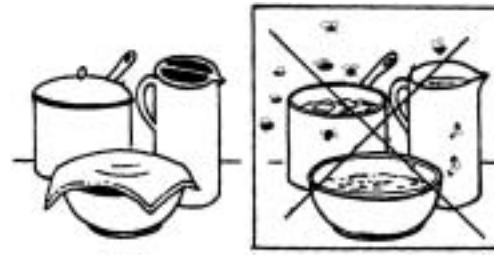

Figure 7: Hygiene (Caribbean Food and Nutrition Institute)

The porridge should always be prepared just before feeding, so bacteria have less chance to grow. When the porridge is cooling down after cooking and before feeding, it needs to be covered with a clean cloth to prevent contamination by flies or in another way.

Education

To ensure that the supplementary food is prepared hygienically it is important to educate those who care for the babies (often not only the mothers!).

Particular emphasis should be placed on the importance of cooking the porridge well, and on preparing it just before feeding, the use of clean utensils (such spoons, pans, cups) and the washing of hands.

Figure 8: Giving education on food safety and hygiene

Fermentation

Another way to increase the hygiene is to ferment the raw materials of which the porridge will be cooked.

Fermentation is the process whereby the raw material becomes the substrate or medium for the controlled growth of micro-organisms. By chopping and boiling, adding ingredients, such as sugar or salt, and environmental factors (such as temperature) the selection and growth of the micro-organisms can be influenced. The growing micro-organisms then produce their own by-product such as acids or antibiotics, eg. by breaking down starches.

Through the process of fermentation cereals become sour and this inhibits the growth of bacteria. The product is then less susceptible to spoilage and can consequently be kept longer. Moreover, as absolutely no growth of these bacteria occur in uncooked cereal either, the porridge when prepared with fermented cereal, can be kept longer. In some countries, like Kenya and Ghana, fermented cereal is sold as standard procedure, and this also constitutes the staple diet for adults.

Example of a fermentation method used to prepare fermented porridge:
- soak grains from dry maize in water for 12 hours
- after pounding, sieving and filtration it is left to ferment in gourds for 48 hours

2.4 Traditional supplementary feeding: improving the quality.

Most infants are breast-fed for the first two years of their lives. Usually an infants first supplementary food is a porridge which consists of a dilution of the main staple dish. This supplementary feed is made up of flour from grain (such as maize) or a tuber (such as cassava). This porridge has several advantages:
- the infants find it tasty;
- it is soft in consistency and easy to swallow;
- readily available; cheap;
- simple to prepare.

Nonetheless, the local porridge on its own as supplementary feeding is often not sufficient. It contains too little energy and nutrients, such as proteins, vitamins and minerals essential for optimal growth. Moreover, by adding water to the flour from cereals or tubers the energy compounds and nutrients become diluted. To get its adequate quota of these essential components the child would need to eat larger quantities of food, which it is unable to do for the present.

plain porridge, thick and sticky

sour, fermented porridge, soft and easy to eat

Figure 9: Sour, fermented porridge is thinner and hence easier for eating (Burgess, A. and King, F.S., 1993)

Enhancing the quality of this traditional infant food can be done by the following methods:

- Roasting the grain, whereby less water is absorbed.
- Fermentation of the cereal, whereby the starch molecules are broken down so that less water is absorbed (if fermentation is done before cooking), or less water clings to it (if fermented after cooking). The prepared product is thinner but contains relatively more energy and nutrients than unfermented porridge. Other advantages are that fermentation increases the absorption of iron, and it inhibits the growth of bacteria in the weaning food.
- Addition of germinated flour also called 'power flour'. This is flour from germinated seeds that gives the porridge more fluidity. The danger of using germinated flour, however, is that it contains vari-

ous bacteria, so that it is important that the porridge is thoroughly cooked.

- The addition of fats, whereby the energy density is increased and the flavour is enhanced. However, no more than 10 g per 100 g should be added.

2.5 Commercially produced supplementary foods

Commercially produced weaning foods are manufactured in factories in large quantities and mainly consist of various kinds of milk powder. They are often advertised and this is why people frequently think that it is the best food that a child could have. The quality of weaning food from small-scale production, however, is just as good, and under the prevailing circumstances in many developing countries, it has many advantages.

Commercially produced weaning food has several advantages: it is easy to prepare, hygienic provided it is packaged and contains the right quantities of energy and nutrients. However, these products are expensive and not available, always and everywhere, locally. Moreover, they are often incorrectly recommended for infants under four months of age. Finally, as these products can be prepared with cold water, it can be risky if the water is polluted and does not need to be not boiled. These products are therefore not advisable for use by the poorer groups in the community. Home-made weaning products or a product that has been produced on a small scale, containing sufficient energy and nutrients, is preferable. Locally produced weaning foods are cheaper, always available locally, and hygienic because they need to be cooked thoroughly.

3 Guidelines for developing a recipe

3.1 Introduction

To help solve the problems surrounding the feeding of young children, a project can be set up locally for the production of weaning foods. Weaning food is a ready-made product consisting of a number of ingredients, which can easily be prepared into a porridge. This cereal should be easy to produce in the home, by a group (for instance, a women's group) for own use, or by a group or organization for own use as well as for sale, or solely for sale.

Prior to starting a project, information on local eating habits must be obtained. The most important questions that need to be answered include:

- Which foods are locally readily available and affordable?
- What are the local eating habits?
- How are the foods divided in the home?
- Which foods are or are not accepted on traditional or religious grounds?
- Has the mother got the freedom at home to actually take heed of the advice given on feeding?
- Is the target group interested in such a product?
- How can these people be involved in the project?

This information can be obtained by:

- Observation
  (what is sold in the market, what are the prices, what is grown in the garden and on the farms, which snacks and meals are sold on the street, what do people eat at home).
- Interviews with mothers.
- Discussions with local organizations, women's groups, and the like.

The results obtained can be used to compile a recipe for the weaning food. The cereal must meet with certain criteria. It must:

- have the correct nutritive value;
- be made from products that are inexpensive and easy to obtain locally;
- consist of products that are locally accepted, also as baby food;
- be easy to prepare into a porridge in the home;
- taste good;
- not be expensive;
- be simple to produce locally on a small-scale.

To guarantee proper nutritive value, as far as possible, a food item should be chosen from all the groups of the Food Square (see Appendix 5) so that the cereal contains all the ingredients for a wholesome food:

1 A cereal as basis (such as rice, wheat, maize or sorghum);
2 A pulse for extra protein (such as beans or peas);
3 Oil seeds for extra energy (such as peanuts or sesame seed).

In the next chapter sample recipes are described.

Adding fruit and vegetables to the recipe makes it impossible to store the weaning food. Therefore fruits and vegetables must be given separately in addition to the porridge.

To ascertain the correct proportions of these products in the cereal it is essential that the energy and protein content of the end product are taken into account. The correct balance of the ingredients can be calculated with the help of the food composition table in Appendix 1 and the directions given below. The porridge is usually prepared using a ratio of one cup cereal to 3 cups water.

3.2 Energy

Several factors play a role in determining the energy value of the weaning food:

- the total energy requirements of the child;

- the quantity of porridge that the child can eat per meal;
- the number of times that the child is fed with the cereal;
- the quantity of breast-feeding or other food that the child gets in addition to the porridge.

Table 1 in Chapter 2 shows the total energy requirements for children per age group. An infant can eat 200 to 300 ml porridge per meal and this porridge should not be very thick. At one year of age, a child should preferably get around four to five feeds of porridge a day, in addition to breast-feeding. If a child is indeed being given the above-mentioned quantities and frequency of supplementary feeding, then an energy density of about 36-48 kcal/100ml (approximately 150-200 kJ/100ml) porridge is enough.

The addition of oil seeds increases the energy density. Besides, the energy density in weaning foods can be further increased by roasting the cereals, pulses, and oil seeds, and by using fermented cereals (see Chapter 2, par: The preparation of baby food in the home). It is also possible to raise the energy value by adding a little oil or sugar to the prepared porridge, but this is not necessary.

3.3 Protein

For good development, it is also essential that the weaning food contains sufficient protein in addition to energy. The protein content of the weaning food should be around 15 g per 100 g. Accurate calculation of the essential protein content can be done using the protein-energy percentage. This is explained in Appendix 2.

The quality of protein in grains and pulses complement each other well. Therefore, the required protein content can be achieved by mixing grain and pulses. For the best results, the ratio of grain and pulses is around 3:1 or 4:1. This means per 100 g, a ratio of 65-75 g grain and 25-35 g pulses. Although pulses are a good source of protein (20-25%) care should be taken not to overdo this because of the anti-nutritional factors present (these can be harmful compounds or com-

pounds that reduce the absorption of other important nutritive substances), longer cooking time, and can cause flatulence.

To improve the protein content further, powdered dry fish can be added. The disadvantage of this is that the smell and taste can be so unpleasant that children often refuse it. Furthermore, in some cultures fish is not accepted. Addition of animal protein becomes essential when breast-feeding is no longer given and the child is fed only with this weaning food for a long period.

3.4 Fibre

Fibre is difficult to digest; therefore the raw fibre content of the weaning food should not be more than 5 g per 100 g.
The fibre contents of a few common food products are the following:

maize flour	1.9 g	fibre/100 g
cassava flour	1.7 g	,,
peanuts	2.9 g	,,
beans, kidney	4.4 g	,,
beans, soya	4.7 g	,,
oils and fats	0 g	,,

More information on various foods can be found in the Food Composition Table in Appendix 1.

3.5 Vitamins and minerals

The mineral and vitamin content in the weaning food will not be enough to cover the daily requirements. In the first six months of life, breast-feeding is sufficient to meet the vitamin and mineral requirements. After six months it is important to give fresh vegetables and fruit in addition to the breast milk and weaning food, for instance, a piece of banana, mango or papaya as a snack. Mashed fruit can also be mixed into the porridge.

When feeding fruits it is important to take care of hygiene. This is done by washing and peeling the fruits (do not wash with unboiled

water after peeling!), using clean utensils and feeding it directly after preparation. See also the paragraph on hygiene in Chapter 2.

Figure 10: Mashed fruit, such as banana or papaya, is a good snack

Some recipes that are currently in use are given in the next chapter. The easiest, cheapest, best-used and most popular recipe is a mixture of:
80% roasted maize
10% roasted beans or lentils
10% roasted peanuts.

4 Sample recipes

4.1 Introduction

Many countries have had a lot of experience with the small-scale production of weaning food. In the next paragraph you find a few popular recipes that have proven to be successful. In the third paragraph you find a recipe of weaning food for treating severely malnourished children.

For some recipes the nutrient composition is given. In Appendix 2 the function and requirements of energy and protein are explained. In the last paragraph advantages and disadvantages of the use of peanuts and of a vitamin/mineral mix is described. The methods of preparing these types of weaning foods will be explained in the next chapter

4.2 Recipes

The quantities of ingredients in the recipes are based on the preparation of 1 kg of weaning food. When you prepare the weaning food in the home for one baby, you can better prepare a smaller quantity in order to prevent it going off.

NUTRIMIX (Ghana)

750 g roasted maize
150 g roasted and peeled soya beans
100 g roasted peanuts

WEANIMIX (Ghana)

800 g roasted cereal (maize, millet or sorghum – depending on which is available in that part of the country)
100 g roasted peanuts
100 g roasted beans

VITALMIX (Ghana)

800 g roasted cereal (sorghum or maize)
100 g roasted chickpeas
100 g roasted peanuts

TOTOMIX (Tanzania)

800 g roasted maize
100 g roasted lentils
100 g roasted peanuts

SOY-OGI (Nigeria)

700 g maize
300 g soya beans
vitamin/mineral mix (see end of this chapter)

Composition per 100 g is approximately:

energy	400 kcal (1.7 kJ)
protein	20 g
protein-energy %	20 %
fat-energy %	14 %

AK-1000 (Haiti)

700 g cereal (maize, rice or sorghum)
300 g pulses (black, white or red beans or peas)

Composition per 100 g (dependent on the type of cereal and pulses used) is approximately:

energy	350 kcal (1.5 kJ)
protein	11.5-14.8 g
protein-energy %	13-17 %
fat-energy %	2-9 %

Farine de bebe de Benin (Benin)

275 g roasted maize
275 g roasted sorghum
205 g roasted beans
140 g roasted peanuts
105 g sugar

Composition per 100 g is approximately:

energy	393 kcal (1.6 kJ)
protein	15 g
protein-energy %	15 %
fat-energy %	20 %

Likuni Phala (Malawi)

500 g germinated maize
250 g peanuts
250 g beans

Composition per 100 g is approximately:

energy	406 kcal (1.7 kJ)
protein	17 g
protein-energy %	17 %
fat-energy %	27 %

BITAMIN (Niger)

670 g barley
200 g niebe beans
100 g peanuts
30 g baobab fruits

Composition per 100 g is approximately:

energy	406 kcal (1.7kJ)
protein	15 g
protein-energy %	15 %
fat-energy %	17 %

4.3 FORTIMIX – for severely malnourished children

In Turiana Hospital in Tanzania a recipe has been developed for treating severely malnourished children: FORTIMIX. The basis of this recipe is TOTOMIX. The nutritional value is intensified by adding sugar, oil and milk powder, as follows:

100 g FORTIMIX is made of:

56 g	Totomix
19 g	Sugar
10 g	Oil
15 g	Dry skimmed milk

This contains per 100 g:

energy	415 kcal
protein	48 kcal
fat	135 kcal
carbohydrates	232 kcal

This is more than the normal Totomix, which contains 381 kcal per 100 grams.

To treat severely malnourished children, a child gets 100 ml porridge per kg bodyweight per day. The child is fed every 3 hours, during the first week.

4.4 Information on the ingredients

Peanuts

Adding a lot of peanuts gives a weaning food a high energy value and increases the good taste. However, a weaning food with a high peanuts content has a greater chance of becoming rancid because of the high fat content. To be able to preserve it longer, the peanuts can be (partly) replaced by maize. Moreover the product is rather costly and there are problems with the consistency of the porridge. An example is Nutrimix, for which the recipe was changed to the recipe for Weanimix because of high cost and short shelf life.

Vitamin/mineral mix

The addition of a vitamin/mineral mix (eg. Soy-ogi) increases the vitamin and mineral composition. However it makes the weaning food unnecessarily expensive, because the vitamin and mineral consumption can be increased by giving the infant mashed fruits. Also adding sugar to the product is extra expensive (eg. Farine de bebe de Benin). A much cheaper and better product can be developed using only the basic ingredients (cereals, pulses and oil seeds) and omitting additives like sugar and milk powder. Only in cases of treating severely malnourished children it is important to add them.

Different types of cereals and pulses

Some recipes give a variety of cereals or pulses that can be used to prepare the weaning food (eg. Weanimix and AK-1000). The advantage of this is that the recipe can be adjusted according to whatever is seasonally or regionally available, without major changes to the energy and nutrient content.

Raw products

The disadvantage with all the recipes using `raw' products is that they take a long time to prepare. They need to be cooked for an extra long time to become edible. Roasting the beans and peanuts before grinding will shorten the preparation time (lower fuel costs) and the product can be kept longer (see Chapter 5 on methods of preparation).

5 The production process and the preparation of weaning foods

5.1 The production process

The production process of weaning foods consists of 5 steps:
1 storage of ingredients/raw materials
2 cleaning
3 roasting
4 grinding and mixing
5 packaging.

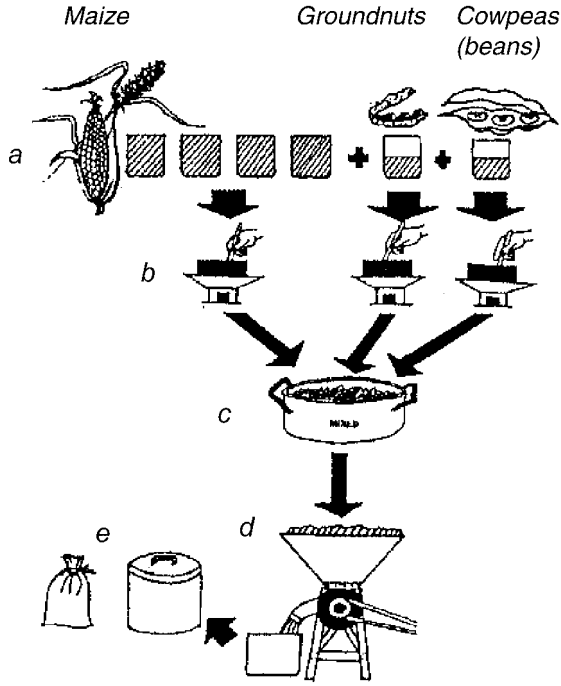

Figure 11: Production process of Vital-mix. a: ingredients; b: roasting; c: mixing; d: grinding; e: packing (Ministry of Health, Ghana, 1995)

In addition to these steps, storage and distribution of the weaning food is important.

1 Storage of the raw materials

If raw materials or ingredients are purchased in small quantities one would not need much storage capacity. Because of price-fluctuations it would then be difficult to produce and sell the product for the same price all-year-round.

Raw materials could also be purchased in large quantities when prices are low, for example, immediately after the harvest period. This does however mean that there must be enough space to store the raw materials in a clean and safe manner. Moreover, there also has to be enough money to buy such big quantities at one period. This could be a problem for some of the projects. Planning is essential, and sometimes, money could be borrowed from local banks or other institutions. Needless to say, the interest that has to be payed on loans should not be more than the financial gain of buying when the prices are low. The storage costs must also be taken into account when comparing the price advantage of the raw materials.

In Ghana, the experience with buying maize just after harvesting was disappointing. The maize was not dry and the project had the extra expenses of having it dried.

If it is possible to purchase all the raw materials in sufficient quantities locally, then it could be an idea to stimulate local farmers to grow the necessary crops, or to make favourable agreements with local producers with respect to price and delivery. Another possibility is to introduce the production of raw materials as a component of the project. Perhaps a women's group that has access to gardens could be encouraged to produce the ingredients required.

In tropical climates, it is essential to store stocks in a clean and safe manner, to prevent perishing and loss. Usually, large plastic bags/bales are used for storage, but also empty oil drums can be used. Oil-seeds,

such as peanuts, cannot be purchased early because much of its nutritive substances are lost during storage and aflatoxin (a toxin) can develop. To prevent this, regular testing must be done, for example by using the salted-water-boiling technique: immerse peanuts in boiling salted water (for instance, one handful salt in one bucket of water). The bad peanuts become discoloured and can then be removed. However, as only small quantities of peanuts are used in the product, they could be purchased locally at the market price when required and in the necessary quantities.

More information about the storage of raw materials you can find in two other publications in this Agrodok-series:
no. 18, *Storage of grain and pulses* and
no. 31, *Storage of tropical agricultural products*.

These publications contain information about:
- the influence of environmental factors and the perishing of raw materials;
- storage of cereals, pulses, oil seeds and root crops;
- protecting raw materials from insects, rats, mice, etc.

These Agrodoks can be ordered from the Agromisa Foundation

2 Cleaning

Cleaning of the ingredient ensures that the ultimate quality of the product is good and that it remains so. The product is checked by hand or simple techniques such as sieving can be used to remove dirt, stones and the like.

3 Roasting

Roasting of the raw materials is very important for the following reasons:
- it reduces the cooking time of the pulses and oil seeds in the end product, and consequently, the preparation time and fuel costs;
- it improves the safety of the product, especially by killing the bacteria and other micro-organisms;
- it prolongs the storage time to about 6 months by inactivating the anti-nutritional factors (natural toxins), which are also present in bitter cassava and soya beans;
- it improves the taste and digestibility of the product.

The ingredients need to be roasted separately. Roasting is done in the customary way, for a few minutes per ingredient, stirring frequently (do not allow to burn). Roasting can be done over flames, charcoal, glowing embers or gas. It is important that a supply of fuel is available throughout the year. It may also be useful to look for alternative fuels that could be cost saving or better for the environment, such as rice chaff or dried animal manure.

4 Grinding and mixing

After roasting, the product must be cooled before mixing the ingredients in the right proportions, which is dependent on the products used and the chosen recipe (see Chapter 3). After mixing, the ingredients must then be grounded. Experience has learned that groups of people usually make use of a mill that is already in use in the village or town, for example, by a baker, miller or agricultural co-operative. If this is not possible, one can also grind or pound the ingredients by hand.

Figure 12: Grinding of grain (Burgess, A. and King, F.S., 1993)

5 Packaging

Packaging of small-scale produced weaning food is usually done by hand, therefore proper hygiene is essential. It is useful to have a sealer to immediately vacuum seal the packet. But this does mean that electricity is required. If no sealer is available, then the plastic packing can be melted and sealed using a candle.

The choice of packaging material is depends on:

- what is locally available;
- the storage time, and:
- the distribution channels. Polyethylene 0.5 mm thick is the preferred choice, usually double packaging, i.e. two bags, one inside the other. An advantage is that it keeps longer. The production costs will however be a little higher.

> In Gambia, cereal packed in a single plastic bag was found to have a shelf life of four weeks. In double plastic bags the shelf life increased to four months. This is of course dependent on local conditions and the choice of product.

Another advantage of double packaging is that a label can be placed between the two plastic bags with at least. The label should at least contain:

- tradename;
- product information;
- shelf-life of the product;
- instructions for preparation and use (they need to be clear enough too for people who cannot read or speak another language).

The label should also clearly state that the weaning food should be given in addition to breast-feeding up to two years of age, and that weaning food is not a substitute for mother's milk.

For commercial sales and customer relations the packaging must be recognizable and attractive. If packaging the weaning food in small quantities is difficult, for instance, either because packing material is not readily available, or because there is little demand for it, then the

required quantity can be measured off into the customer's canister or tin. Here, it is vital that these persons are well instructed about the importance of hygiene when storing and preparing the weaning food at home. Weaning food must always be cooked thoroughly!

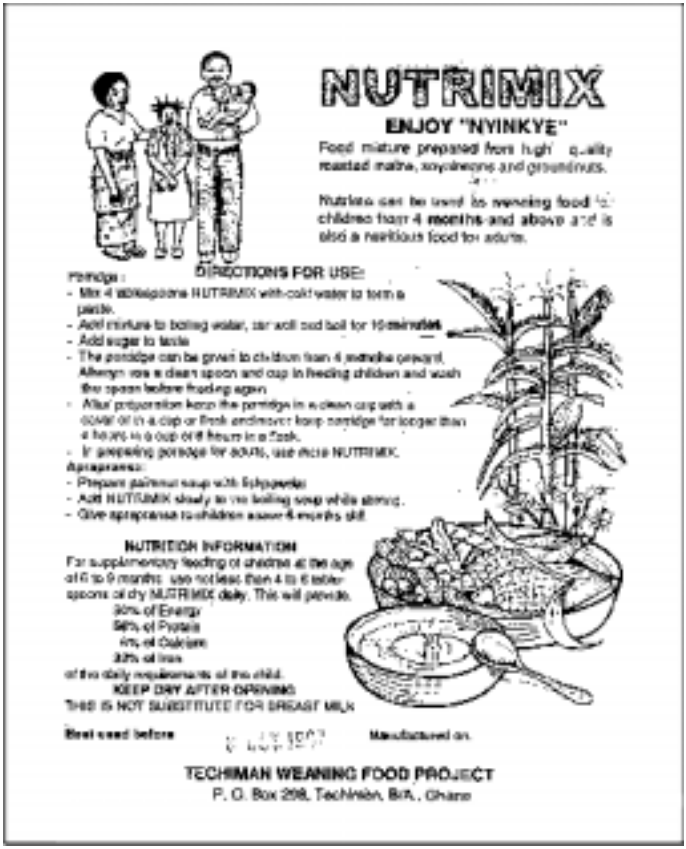

Figure 13: Example of label from Ghana

5.2 Necessary equipment and other requirements

The production area is usually simple: a room in the home, communal space, or sometimes outside on the property of one of the participants.

What is important is that production takes place in a safe and hygienic manner. For example, there should not be any children playing in the direct environment and cattle or other animals should have no access to the production area.

Besides the space for production and storage there is also need of a place where the selling and/or administration can take place.

If the cereal is not offered for sale ready packed, then a standard weight should be fixed, such as a specified tin. Sometimes scales can be used from a seller from the market or from a shop. Standard weights are also needed for fixing the proportions of the basic ingredients for mixing.

More information on the preparation of weaning food at home is given in Chapter 2.

6 Management, marketing and financial aspects

6.1 Introduction

Many countries have had years of experience with small-scale production of weaning food from locally available products. From these experiences we have learned to know what are the important points to increase the chances of success. This chapter treats these important aspects first for the small-scale production of weaning food, for instance, by a women's group or at village level. Later in the chapter the points of importance for small-scale factory approach are treated briefly. Even though experience has shown that this last approach is more difficult to bring about. Finally, an example from Tanzania is discussed.

6.2 Objective and target group

The main objective of small-scale weaning food production is usually to contribute towards improving the health and nutrition status of young children. Objectives could also be income generation and job opportunities. Nonetheless, the production, sale and use of the weaning food will never be able to sustainably improve the food situation, unless it were to come under a much larger programme involved with the important issues of nutrition and health care education.

Other advantages of local production of weaning food are: the creation of distribution channels for local agricultural products; autonomy of, for instance, women's groups or local communities; independence from food aid or other help from outside and acquiring know-how, skills and experience.

The target group of the weaning food produced on a small scale is often the `poor and middle classes' of a population. Children in these groups frequently suffer from malnutrition. Moreover, these people

are often unaware about information on good food and nutrition, the relationship between nutrition and health and the necessity for special weaning foods. A dilemma is that the `poorer' segment of the population often does not have enough money to buy this food. As a solution, women who contribute towards production by way of labour and/or basic ingredients, could be given the weaning food as payment.

One should assume that the better off will not be interested in this type of locally produced products. More likely, their preference would be for products with much status and would therefore prefer to buy the more expensive imported brands.

The small-scale projects can be either urban or rural. What is essential is that the production/distribution is continually adjusted to meet the demand. Planning, monitoring and evaluation of the entire process of market research, production, marketing and education is of vital importance.

6.3 Preparation

As mentioned in Chapter 3, information will need to be gathered on the local eating habits and the ingredients/raw materials that are locally available. To do this the following questions need to be answered:

- Will the target group accept the weaning food?
- With regard to taste and image, what are the wishes and opinions of the target group? What do people associate with the product; do they or do they not see it as having a healthy image?
- What are the religious or other cultural beliefs of the target group concerning (a child's) food?

The answers to these questions together with the availability of the various ingredients can then be used to compile a recipe for the production of the weaning food. The answers to the questions will also help formulate the guidelines for the information about the product.

Weaning food usually consists of a mixture of one type of grain, a pulse and an oil seed. Before starting the production of weaning food, it would be useful for the organizers and fellow workers to visit similar projects to exchange experiences and ideas.

It is necessary that the production and sale of the weaning food fits in with the local activities on nutrition and health care education. Therefor you have to seek co-operation locally with health care workers, women's groups, the local government and perhaps even pharmacies and hospitals or health care posts. In some cases you could seek contact with international organizations. Depending on the local situation it may be possible that the international organizations buy a portion of the distribution, and subsidize or distribute it free-of-charge in the health sector and/or at information sessions.

6.4 Management

It would appear that much creativity is needed when a project starts, mostly to do with publicity, marketing and the purchasing of raw materials. The participants in the project should be given good training on production techniques, product information, marketing, financial aspects and bookkeeping. Preferably, regular meetings ought to be arranged with other groups engaged in similar activities, so that good and bad experiences can be exchanged. Furthermore, a good network of organizations and institutions is important, where one could turn to for any kind of information, and through whom it might be possible to advertise or get (financial) support for the project.

6.5 Marketing and publicity

If the project's production of weaning food is successful enough to supply both the participants and the market, then good marketing and publicity is important. In this type of situation one usually makes use of social marketing. This means cooperation between the weaning food project and the government and/or NGOs (health sector). The project takes care of the production and distribution while the gov-

ernment/NGO does the promoting and educating. Consequently, much is achieved at little cost to the project. The ultimate purpose is the promotion and use of the product through information on food and by cooking demonstrations.

One also has the choice (depending on the local circumstances) of selling a part of the product to hospitals, pharmacies or health centres – with or without a discount. This will enable it to be used to improve the feeding of sick and/or undernourished children. It is important that the parents or caretakers of these children know that this same weaning food cereal that has made their child better is also available through the project. They could then use it to enhance the normal diet of the child.

Figure 14: Posters are a simple and inexpensive way of advertising (Caribbean Food and Nutrition Institute)

Knowledge of the market is very important at all times. One must keep track of people's preferences to be able to take advantage of their needs and wishes. A product must be widely known by its name. This can be done in various ways, from word-of-mouth advertising to the use of radio, posters, etc. Publicity is dependent on the funds that the project has at its disposal and on the size of the production. It is virtually impossible to compete with the expensive advertising campaigning of imported infant foods.

6.6 Distribution

Different projects produce different quantities of the end product per packaging, dependent on the local circumstances. In Ghana and Benin

packages contain 500 g, whereas in Gambia the packages contain 200 g. In the last-mentioned, the choice of the smaller amount was to prevent it from going off after being opened and by prolonged storage.

Distribution can be done in several ways, depending on the production target. When the products are solely for use by the children of participants of the project, the distribution channels are straightforward.

Sometimes the weaning food can only be bought directly at the place of production. Sometimes the product needs to be distributed to shops, hospitals, baby clinics, individual sellers (market), and pharmacists.

What is important is:
- Where can the weaning food be bought and is the consumer able to get there?
- Is the cost of the distributive trade too high?

6.7 Financial aspects

The costs of production of the weaning food, dependent on the local circumstances and manner of production, are built around the following factors:
- ingredients
- debts and rental of building, investments/equipment
- maintenance and repair of equipment
- transport of the raw materials, and of the end product
- storage of raw materials and end product
- materials for packaging
- salaries and taxes, if any
- margins for the distributive trade
- publicity and promotion (these could be kept relatively low in the case of `social marketing')

Investments should be kept as low as possible in small-scale production of weaning food. Small-scale production can be done with a bare minimum of equipment and labour. The administration should be done

well and is invaluable to the progress and planning of the activities, dependent on the scale of production.

To fix the sales price of the weaning food the following factors must be taken into consideration:

- Can the target group afford this price (is price of the weaning food compatible with the purchasing power of the target group)?
- Does the higher purchase price of the weaning food weigh up against the time saved in preparing it?

6.8 Factory approach to production

The experience with a factory approach to weaning food production has shown quite some difficulties. The reasons include: heavier overheads (higher costs for collecting the raw materials, storage, salaries and taxes), necessary investments and marketing problems. Nevertheless, we will mention a few aspects here. For one, the Royal Tropical Institute in the Netherlands has a great deal of experience with the factory approach to weaning food production.

The aim of these projects is largely the same as that of a small-scale production. However, job opportunities (in the production process as well as in selling) and the self-sufficiency and the up-keep of the factory, has then got higher priority. The target group of the weaning food produced in this manner is often the middle class of a community, because the commercial sale of the product is of significance for the continuity of the factory.

The annual production is usually estimated at between 15 and 500 tons. The size of the operation and project is dependent on the potential market. Production at this level will be achievable particularly in (in the neighbourhood of) urban areas.

The production process of the factory-style produced weaning food consists of the same six steps (see Chapter 5). The raw materials should preferably be bought in large quantities and when prices are

low. For production, experience has shown that it is essential to have a storage capacity of a minimum of six months. Essential too is that the production areas can be kept clean, i.e., floors must be flat, walls painted, etc. Furthermore, there must also be toilets, washing and changing rooms for the staff.

Machines and equipment must be suitably adapted to local circumstances, easy to use and easy to maintain. Moreover, any necessary spare parts ought to be obtainable locally or from the capital. Often, there is one trained person who is responsible for the maintenance.

Experience shows that this factory approach of weaning food production can be cost-effective or self-sufficient only if customers from institutions (such as, hospitals, aid organizations, World Food Programme, etc.) buy a fixed quantity of a minimum of 50-60% for the first few years.

Risks and problems that could occur are:

- Equipment undermanned – the risk that the equipment cannot always be used to full capacity, among other things, owing to an inconsistent demand and possible transport problems.
- Raw materials – a poor harvest can have a direct effect on the supply of raw materials. Moreover, the quality of the raw materials could be difficult to achieve and maintain (because of the presence of stones, sand and other varieties of grain).
- Equipment – often local industry for the manufacture and maintenance of the equipment is sadly lacking.

Increase in productivity could then be achieved by cooperation between different producers (stability of the price of raw materials could be achieved by lower costs of marketing and publicity, and by joint purchase and exchange of stocks) or by production diversification (making other products with the same equipment).

6.9 Totomix programme: an example from Tanzania

In Tanzania a start has been made with the production of weaning food following a study tour of similar programmes by two Tanzanians in Ghana. In Ghana, different approaches were found alongside each other, like a factory where `large-scale' weaning food was being produced, and women's groups preparing `small-scale' weaning food for themselves and for sale. Based on this study tour it would appear that a factory approach is more often expensive and brings with it rather a lot of marketing problems. Therefore, a decision was made to start off with small-scale production in Tanzania.

In 1992 the production of weaning food was commenced in two places in Tanzania, one of them being the Turiani hospital in Morogoro (Totomix). The reason to start here was that a study had been done on the food and nutrition situation in the region and it was discovered that malnutrition was very common. 55% of the children were too small for their age. One of the causes was attributed to late and poor supplementary feeding.

In Turiani hospital, the weaning food is prepared in a central place and there is adequate demand and purchasing power among those in the target group: the women often work as labourers on the sugar plantation and have no time to prepare the weaning food themselves. The quantity produced is adjusted to meet the demand. The weaning food is used in the hospital as well as being sold to people in the neighbourhood. It is used for preventive and curative purposes. Hence, for prevention of malnutrition and for treatment of it. For treating severe cases of malnutrition, Turiani hospital has nowadays developed an appropriate cereal called Fortimix, which has a higher nutritional value. (In Chapter 4 you can find the recipe of Fortimix.)

Around the weaning food issue, much emphasis is placed on education about food, also explaining why supplementary feeding is so essential. Financial support was originally only to help towards the purchase of basic foodstuffs, material for packaging, equipment for cook-

ing and salaries. To support the sale of the cereal at cost price this fund continues to be topped-up.

In 1994, Turiani prepared 3227 kg weaning food. This has gradually risen to 7024 kg in 1995.

This programme now serves as an example for others and the idea has spread to Tanzania. It is now being done in a total of 18 places. The manner in which this cereal is made differs from place to place and is dependent on the needs of the target group. Does one buy a bag of cereal and does one have enough money to pay for it, or does one preferably make ones own weaning food?

Twelve of the eighteen projects work with women's groups (community based), the other six have opened a small factory. In Tabora, for example, the weaning food is made on a very small-scale by four women's groups: the women see this as an income generating programme so that they can earn money to buy food and for other articles for their family, while at the same time getting cereal to feed their own children. Two years on, there are now ten women's groups preparing weaning food.

Appendix 1: Food composition table for use in Africa

See the following pages.

Explanation of abbreviations/symbols used in the tables:

% EP: Edible Portion in percentage
RE: Retinol Equivalents (micrograms)

* : Vitamin A content varies
┼: If fortified with vitamin A

Additional information:
In table 1: in Chapter 2 you can find the daily needs of children for energy, protein, fat, iron and vitamins.

In Appendix 2 explanation is given on energy and protein. Appendix 3 treats different vitamins and minerals, their functions and requirements.

Table 2: Food composition table for use in Africa (1a)

Food	% EP	In 100 g edible portion of food				
		Water (g)	Energy (kcal)	Pro-tein (g)	Sugar (g)	Starch (g)
Dry cereals						
Maize:						
whitefresh on cobflour,	70	58	165	5.0	2.0	32
wholegrainflour,	100	12	345	10.0	-	67
refined, 60-80% extraction	100	12	335	8.0	3.0	74
Maize:						
yellowflour, wholegrain	100	12	340	9.3	5.0	74
Millet						
finger, flour	100	13	320	5.6	0	75
bulrush, flour	100	16	335	11.0	0	69
Rice:						
polished	100	12	335	7.0	0	80
parboiled	100	14	335	7.0	0	80
Sorghum						
flour, wholegrain	100	11	335	9.5	1.0	73
Wheat						
flour, white, 85% extraction	100	12	340	11.0	2.0	72
bread, white	100	37	240	7.7	4.0	47
bread, brown	100	38	235	7.7	3.0	47
Pasta	100	12	342	12.0	(74)	
Chapatti (made with fat)	100	29	328	8.1	(48)	
Starchy roots and fruits						
Breadfruit	66	73	96	1.3	(23)	
Cassava						
fresh	74	60	140	1.2	5.0	30
dried or flour	100	13	342	1.6	13.0	69
Coco-yam/taro fresh	84	65	133	1.8	2.0	21
Plantain/Cooking banana	66	65	130	1.2	7.0	25
Gari	100	13	351	1.0	(95)	
Potato						
fresh-round (Irish)	86	78	75	1.7	1.0	17
sweet	79	69	121	1.6	3.0	25
Yam,						
fresh	84	69	110	1.9	0.6	27
flour	100	14	335	3.4	0	78

Table 2: Food composition table for use in Africa (1b)

Food	In 100 g edible portion of food					
	Fat (g)	Fibre (g)	Iron (mg)	Vit.A (RE)	Folate (µg)	Vit.C (mg)
Dry cereals						
Maize:						
whitefresh on cobflour,	2.1	0.8	3.6	0	?	0
wholegrainflour,	4.5	1.9	2.5	0	?	0
refined, 60-80% extraction	1.0	0.6	1.1	0	?	0
Maize:						
yellowflour, wholegrain	3.8	1.9	4.2	54	?	3
Millet						
finger, flour	1.4	2.6	5.0	4	?	0
bulrush, flour	3.5	2.0	3.0	?	?	0
Rice:						
polished	0.5	0.1	1.0	0	29	0
parboiled	0.8	0.1	1.7	0	29	0
Sorghum						
flour, wholegrain	2.8	2.1	4.5	3	?	0
Wheat						
flour, white, 85% extraction	2.0	0.8	3.6	0	51	0
bread, white	2.0	3.0	1.7	0	28	0
bread, brown	2.0	5.0	2.2	0	37	0
Pasta	1.8	5.0	2.1	0	34	0
Chapatti (made with fat)	12.8	3.7	2.3	0	15	0
Starchy roots and fruits						
Breadfruit	0.3	1.3	0.7	3	?	12
Cassava						
fresh	0.2	1.1	1.0	5	24	31
dried or flour	0.5	1.7	2.0	0	?	4
Coco-yam/taro fresh	0.3	1.0	1.2	0	?	8
Plantain/Cooking banana	0.3	0.5	2.0	0	22	6
Gari	1.1	1.9	1.3	130	16	20
Potato						
fresh-round (Irish)	0.1	0.6	1.1	3	14	21
sweet	0.2	1.0	2.0	*300	52	37
Yam,						
fresh	0.2	0.8	0.8	4	?	17
flour	0.4	1.6	1.1	0	-	0

Table 2: Food composition table for use in Africa (2a)

Food	%EP	In 100 g edible portion of food				
		Water (g)	Energy (kcal)	Protein (g)	Sugar (g)	Starch (g)
Dried legumes (seeds)						
Bambara nuts	75	10	345	19.0	(61)	
Beans,kidney	100	12	320	22.0	1.0	56
Chickpeas	100	10	325	20.0	11.0	46
Cowpeas	100	11	320	23.0	7.0	50
Groundnuts	70	7	570	25.0	(23)	
Lentils	100	10	325	25.0	3.0	54
Mungbean	100	10	340	24.0	2.0	53
Peas	100	11	320	22.0	3.0	53
Pigeon peas	100	10	322	20.0	7.0	51
Soybeans	100	11	405	38.0	0	29
Oil seeds						
Coconut						
immature fresh	16	68	190	2.0	?	
mature flesh:						
fresh	48	43	390	3.6	(35)	
dried	100	2	735	6.0	(20)	
water	100	96	14	0.2	(3)	
milk cream	100	54	320	5.0	(6)	
Melon seeds	75	6	595	26.0	(15)	
Sesame seeds	100	5	592	20.0	(22)	
Sunflower seeds	50	6	486	13.0	(51)	
Vegetables, fresh unless described differently						
Bean, fresh seeds	100	89	35	2.5	4.4	2
Carrots	74	89	35	0.9	8.2	0
Eggplant	78	90	30	1.0	6.0	0
Okra pods	81	89	35	2.1	(7)	
Onion	94	88	38	1.2	7.0	2
Pepper, sweet, green/red	86	86	44	2.0	7.7	0
Pumpkin/Squash fruit	77	93	23	1.0	2.0	3

Table 2: Food composition table for use in Africa (2b)

Food	In 100 g edible portion of food					
	Fat (g)	Fibre (g)	Iron (mg)	Vit.A (RE)	Folate (µg)	Vit.C (mg)
Dried legumes (seeds)						
Bambara nuts	6.2	4.8	12.0	2	?	0
Beans, kidney	1.5	4.4	8.2	3	180	1
Chickpeas	3.7	6.7	5.5	11	180	8
Cowpeas	1.4	4.8	5.0	3	439	2
Groundnuts	45.0	2.9	3.8	3	110	1
Lentils	1.2	3.9	7.0	10	35	0
Mungbean	1.1	4.9	8.9	19	120	5
Peas	1.1	5.7	10.0	27	33	0
Pigeon peas	1.3	7.3	5.0	9	100	0
Soybeans	20.0	4.7	6.1	9	210	0
Oil seeds						
Coconut						
immature fresh	17.0	3.7	1.8	0	14	8
mature flesh:						
fresh	39.0	6.6	2.5	4	26	2
dried	70.0	21.0	3.6	0	9	0
water	-	-	-	0	?	-
milk cream	35.0	?	2.0	0	?	-
Melon seeds	50.0	4.0	7.4	0	?	-
Sesame seeds	50.0	4.1	8.1	0	97	2
Sunflower seeds	27.7	2.6	7.6	0	?	0
Vegetables, fresh unless described differently						
Bean, fresh seeds	0.2	1.8	1.8	27	36	25
Carrots	0.1	1.4	0.7	1088	8	8
Eggplant	0.2	1.3	1.3	6	29	9
Okra pods	0.2	1.7	1.2	32	23	47
Onion	0.1	1.0	0.8	0	14	11
Pepper, sweet, green/red	0.8	2.6	2.6	290/ 458	24	140
Pumpkin/Squash fruit	0.1	0.8	1.4	292	8	8

Table 2: Food composition table for use in Africa (3a)

Food	%EP	In 100 g edible portion of food				
		Water (g)	Energy (kcal)	Pro-tein (g)	Sugar (g)	Starch (g)
Vegetables, fresh unless described differently contd.						
Leaves						
pale green	63	91	26	1.7	4.8	0
medium green	80	92	25	1.8		(3)
dark green	80	80	58	4.5		(7)
amaranthus	76	84	45	4.6	0	7
baobab	82	77	67	3.8		(13)
cabbage	85	79	19	1.4		(3)
cassava	80	80	50	6.0		(7)
cowpea, fresh	95	85	45	4.7	1.3	5
cowpea, dried	100	10	270	28.0	7.8	30
pumpkin	77	89	25	4.0	0.5	2
sweet potato	80	83	49	4.6	-	-
Tomato	96	94	22	1.0	3.0	1
Ripe fruit, fresh unless described differently						
Avocado	50	80	120	1.4	3.0	1
Baobab	28	16	280	2.2		(67)
Banana	63	77	82	1.5	17.0	3
Dates, dried	83	17	295	2.7	70.0	4
Guava	81	82	46	1.1		(5)
Lemon/lime	59	90	40	0.6	5.0	3
Mango	72	83	60	0.6	13.0	2
Orange/tangerine	75	88	44	0.6	9.0	1
Pawpaw	74	91	30	0.4	6.4	1
Pineapple	55	87	48	0.4	12.0	0
Water melon	50	94	22	0.5	5.1	0
Sugars						
Honey	100	23	286	0.4	76.0	0
Jam	100	29	234	0.4	69.0	0
Sugar						
refined white	100	0	400	0	100.0	0
cane juice	45	82	54	0.6	13.0	0

Table 2: Food composition table for use in Africa (3b)

Food	In 100 g edible portion of food					
	Fat (g)	Fibre (g)	Iron (mg)	Vit.A (RE)	Folate (µg)	Vit.C (mg)
Vegetables, fresh unless described differently contd.						
Leaves						
pale green	0.1	1.2	0.7	16	79	54
medium green	0.2	0.9	1.8	300	50	41
dark green	0.3	2.0	7.2	550	105	80
amaranthus	0.2	1.8	8.9	383	85	50
baobab	0.3	2.8	1.1	?	?	52
cabbage	0.2	0.7	0.7	64	75	39
cassava	1.0	4.0	7.6	500	?	?310
cowpea, fresh	0.3	2.0	5.7	117	135	56
cowpea, dried	1.8	12.0	35.0	600	690	290
pumpkin	0.2	2.4	0.8	167	?	80
sweet potato	0.2	2.4	6.2	510	?	70
Tomato	0.2	0.6	0.6	74	28	26
Ripe fruit, fresh unless described differently						
Avocado	11.0	1.8	1.4	88	22	18
Baobab	0.8	6.8	7.4	13	?	270
Banana	0.1	0.9	1.4	20	19	9
Dates, dried	0.6	3.9	2.0	5	20	0
Guava	0.4	5.3	1.3	48	7	325
Lemon/lime	0.8	0.7	0.7	2	10	45
Mango	0.2	0.9	1.2	400	7	42
Orange/tangerine	0.4	0.6	0.1	122	37	46
Pawpaw	0.1	0.9	0.6	200	1	52
Pineapple	0.1	0.5	0.4	15	11	34
Water melon	0.1	0.4	0.3	42	3	8
Sugars						
Honey	0	0	0.4	0	0	0
Jam	0	-	0.3	-	0	10
Sugar						
refined, white	0	0	0	0	0	0
cane juice	0.1	0	2.0	0	0	0

Table 2: Food composition table for use in Africa (4a)

Food	% EP	In 100 g edible portion of food				
		Water (g)	Energy (kcal)	Pro-tein (g)	Sugar (g)	Starch (g)
Milk						
Breast milk						
mature	100	88	70	0.9	7.3	0
colostrum	100	87	58	2.3	5.3	0
Cheese, hard	100	39	384	24.0	-	0
Cow's milk						
whole fresh	100	87	66	3.5	4.9	0
whole dried	100	4	465	26.0	38.0	0
skimmed fresh	100	90	38	3.5	4.4	0
skimmed dried	100	4	355	36.0	51.0	0
whole soured	100	87	66	3.5	4.9	0
evaporated canned	100	74	140	7.0	10.0	0
condensed sweetened canned	100	29	317	7.3	54.0	0
Goat's milk, fresh	100	84	84	3.4	7.0	0
Meat, poultry and eggs						
Meat without fat: beef, sheep, goat, pig, wild animals	100	68	115	22.0	0	0
Fat from meat	100	6	846	0	0	0
Meat with some fat	100	63	235	18.0	0	0
Blood	100	78	80	17.8	0	0
Liver	100	70	135	19.0	5.0	0
Chicken/poultry	67	72	140	20.0	0	0
Egg, chicken	88	75	140	12.0	0	0
Termites, fresh	100	45	340	20.0	4.5	0
Caterpillars, dried	100	9	390	53.0	(12)	
Drinks and liquids						
Beer						
commercial, 3.9% alcohol	100	92	30	0.9	3.0	0
local, 3.5% alcohol	100	90	25	0.2	?	?
Sodas	100	87	45	0	12.0	0

Table 2: Food composition table for use in Africa (4b)

Food	In 100 g edible portion of food					
	Fat (g)	Fibre (g)	Iron (mg)	Vit.A (RE)	Folate (µg)	Vit.C (mg)
Milk						
Breast milk						
mature	4.2	0	0.04	47	5.2	4
colostrum	2.9	0	0.045	89	2	4.4
Cheese, hard	32.0	0	0.5	332	40	-
Cow's milk						
whole fresh	3.7	0	0.05	52	5	1
whole dried	28.0	0	0.5	288	37	0
skimmed fresh	0.8	0	0.1	0	6	0
skimmed dried	0.8	0	1.0	┼1500	50	0
whole soured	3.7	0	0.05	52	5	1
evaporated canned	8.0	0	0.2	77	8	2
condensed sweetened canned	8.0	0	0.2	84	11	2
Goat's milk, fresh	4.9	0	0.1	25	?	1
Meat, poultry and eggs						
Meat without fat: beef, sheep, goat, pig, wild animals	1.9	0	4.6	-	15	0
Fat from meat	94.0	0	0	0	0	0
Meat with some fat	18.0	0	3.6	25	7	0
Blood	0.1	0	?44.0	21	1	0
Liver	4.7	0	10.0	*1500	250	15
Chicken/poultry	6.5	0	1.1	85	8	0
Egg, chicken	10.0	0	2.0	200	25	0
Termites	28.0	0	1.0	0	?	?
Caterpillars, dried	15.0	0	2.3	?	?	3
Drinks and liquids						
Beer						
commercial, 3.9% alcohol	0	0	0.1	0	?	0
local, 3.5% alcohol	-	0	0.3	0	-	0
Sodas	0	0	0	0	0	0

Table 2: Food composition table for use in Africa (5a)

Food	% EP	In 100 g edible portion of food				
		Water (g)	Energy (kcal)	Pro-tein (g)	Sugar(g)	Starch(g)
Fish and seafood						
Fish flesh, fresh fresh water sea water	 60 60	 75 81	 115 73	 22.0 17.0	 0 0	 0 0
Fish, dried, large small	varies 100	14 20	255 320	47.0 44.0	0 0	0 0
Fish, dried, salted, large (cod)	varies	32	248	54.5	0	0
Prawns & shellfish, fresh	varies	77	94	18.0	(2)	
Sardines canned in oil	100	50	309	20.0	0	0
Oils and fats						
Animal fat/lard	100	1	890	0	0	0
Butter	100	21	700	0	2	0
Cooking fat	100	?	890	0	0	0
Ghee, animal vegetable	 100 100	 - -	 898 898	 0 0	 - -	 0 0
Margarine	100	15	745	0	0	0
Red palm oil fresh old	 100 100	 1 1	 890 890	 0 0	 0 0	 0 0
Vegetable oil	100	0	900	0	0	0
Manufactured/commercial foods						
Baby cereals, various	100	-	377	16.0	30.0	37
Baby "meals" canned/bottled	100	-	380	16.0	10.0	46
Biscuits plain	100	8	407	9.0	(74)	
Doughnut/mandazi	100	24	390	3.1	(50)	
Potato crisps	100	93	36	3.5	(2)	
Soymilk	100	-	385	0	99.5	0
Sweets/candy	100	2	546	5.6	(49)	

Table 2: Food composition table for use in Africa (5b)

Food	In 100 g edible portion of food					
	Fat (g)	Fibre (g)	Iron (mg)	Vit.A (RE)	Folate (µg)	Vit.C (mg)
Fish and seafood						
Fish flesh, fresh fresh water sea water	 3.0 0.5	 0 0	 1.7 1.5	 0 28	 12 12	 0 -
Fish dried, large small	7.4 16.0	0 0	4.9 8.5	0 ?	? ?	0 0
Fish, dried, salted, large (cod)	1.7	0	2.8	0	?	0
Prawns & shellfish, fresh	1.5	0	1.6	108	65	0
Sardines canned in oil	25.0	0	2.7	58	16	0
Oils and fats						
Animal fat/lard	99.0	0	0	0	0	0
Butter	77.0	0	0	731	-	0
Cooking fat	99.0	0	0	0	0	0
Ghee, animal vegetable	 99.8 99.8	 0 0	 0.2 -	 760 ┼680	 0 0	 0 0
Margarine	83.0	0	0	┼680	-	0
Red palm oil fresh old	 99.0 99.0	 0 0	 0 0	 *5000 *2400	 0 0	 0 0
Vegetable oil	100.0	0	0	0	0	0
Manufactured/commercial foods						
Baby cereals, various	5.0	?	20.0	750	75	50
Baby "meals" canned/bottled	7.0	?	20.0	750	75	50
Biscuits plain	7.8	?	1.5	0	13	0
Doughnut/mandazi	18.8	?	1.2	-	-	0
Potato crisps	1.5	0	0.6	0	19	0
Soymilk	0	0	0.2	0	0	0
Sweets/candy	37.6	10.7	1.8	0	40	27

Table 2: Food composition table for use in Africa (6a)

Food	% EP	In 100 g edible portion of food				
		Water (g)	Energy (kcal)	Protein (g)	Sugar (g)	Starch (g)
Food-Aid foods						
Bulgur wheat	100	10	354	11.2	(80)	
Corn soy blend/ wheat soy blend	100	9	360	20.0	(60)	
Corn soy milk/ wheat soy milk	100	9	380	20.0	(62)	
High protein biscuits	100	?	450	20.0	?	?
Rolled oats	100	10	363	13.0	?	?
Soy-fortified cornmeal	100	10	392	13.0	(72)	
Soy-fortified wheat flour	100	10	355	14.0	(70)	

Table 2: Food composition table for use in Africa (6b)

Food	In 100 g edible portion of food					
	Fat (g)	Fibre (g)	Iron (mg)	Vit.A (RE)	Folate (µg)	Vit.C (mg)
Food-Aid foods						
Bulgur wheat	1.5	?	7.8	0	38	0
Corn soy blend/ wheat soy blend	6.0	?	20.0	500	?	40
Corn soy milk/ wheat soy milk	6.0	?	18.0	510	200	40
High protein biscuits	20.0	?	25.0	0	?	63
Rolled oats	7.0	?	4.0	0	24	0
Soy-fortified cornmeal	1.5	?	4.8	228	?	0
Soy-fortified wheat flour	1.2	?	?	0	?	0

Appendix 2: Energy and protein: functions and requirements

Energy

Energy is essential for growth, vital bodily functions (heart function, respiration) and physical activity. The energy value of food is expressed in kcal/g or kcal/ml. One kilo calorie (kcal) is equivalent to 4.18 kilo joules (kJ). The FAO/WHO have made guidelines for the daily needs of children, dependent on the age and weight of a child. For children between one and 2 years of age 1250 kcal per day is recommended (see table 1).

Protein

Protein is necessary for the structure, building and functioning of the cells in the body, such as tissues (muscles, bones, teeth, etc.) and body fluids (hormones, enzymes, blood). Protein is also used for cell growth and repair. The quantity of protein in food is largely determined by the quality of the food, because this is the bearer of many other vitamins and minerals. It is therefore vital that infant foods contains adequate protein.

Protein is usually expressed by the protein-energy percentage. This is the percentage of the total energy in the food provided by proteins. The protein-energy percentage can be calculated using the following formula:

$$\frac{\text{protein (g)} \times 4}{\text{total energy}} \times 100 = \text{protein energy \%}$$

To satisfy the protein needs, the protein-energy percentage of the food for children should be approximately 12-15 %. However, this only applies to food containing sufficient energy. If this is not the case, then the body will use the protein as energy source instead of building compound.

There are qualitatively different types of protein in different kinds of foods. Hence, protein-rich foods are not all qualitatively equally good

for a human diet. By eating a mixture of these foods the protein composition can, however, be improved. A good balance of protein can be found by combining:

- cereals and animal protein, for example, rice with fish;
- cereals and pulses, for example, maize with beans.

Appendix 3: Vitamins and minerals: functions and requirements

Vitamin A

Vitamin A is essential for the eye function, bone formation, the immune system and for growth and reproduction. In food, vitamin A can be found in two forms:

1 Retinol, especially in liver and also in meat, fish, eggs and milk.

2 Pro-vitamin A (carotene), which is converted in the body into vitamin A. It is mainly found in vegetables, such as: dark green leafy vegetables, yellow or orange vegetables and fruit (carrot, pumpkin, papaya, mango, etc.) and red palm oil.

Vitamin C

Vitamin C (ascorbic acid) is essential for the healing of wounds and the forming of collagen (the characteristic component of supporting tissue, such as connective tissue. Furthermore, it plays a role in the absorption and metabolism of iron. Vitamin C is mainly found in vegetables and fruit. For babies, breast milk is a good source of vitamin C.

Iron

Iron is a component of haemoglobin and myoglobin, compounds that play a role in the supplying of oxygen. Only a small portion of the iron is absorbed from the food. How much this is depends on the following factors:

- The total amount of iron in the meal.
- The food source of iron. The iron in animal foods is absorbed well. Iron in vegetable foods is present in a complex form and first needs to be converted. This is poorly absorbed and must be broken down first before the body can use it as iron. The absorption of iron from breast milk is excellent.

- Other foods in the meal. Vitamin C converts iron into a form that enables good absorption of it. Fibres, which are present in grain reduce the absorption of iron.
- The iron status of the individual. If the need is greater, then absorption is high and excretion low.
- The condition of the digestive system. Infection lowers the absorption of iron.

Iodine

Iodine is vital for the thyroid hormones. These hormones control various processes in the body, such as:

- The development of the brains and the central nervous system;
- The manner in which energy is used by the body, and the heat regulation of the body.
- The growth of children.

Iodine is found in plants and animals in areas where the soil contains much iodine. Sea food is rich in iodine. Nowadays, the salt in many countries is enriched with iodine.

Calcium

Calcium is necessary for the building of bones and teeth. Vitamin D (made in the body under the influence of sunlight) is important for the absorption of calcium. Calcium is found in large quantities mainly in breast milk, milk and milk products, beans and peas.

Appendix 4: The growth chart

The Growth Chart is developed by the World Health Organization.
Two weight-for-age curves are usually given on a growth chart: the upper curve being the reference growth curve; and the lowest one the lowest acceptable limit for a healthy weight. A third curve plotted on some of the charts usually indicates the upper limit of a healthy weight. Length, weight and age can also be used to calculate weight-for-height and height-for-age. These values can also be compared with the reference values of the WHO (not included in this publication). More information about the use of the growth chart can be found in '*The growth chart – a tool for use in infant and child health care' by the WHO, Geneva, 1986.*

For example see figure 15.

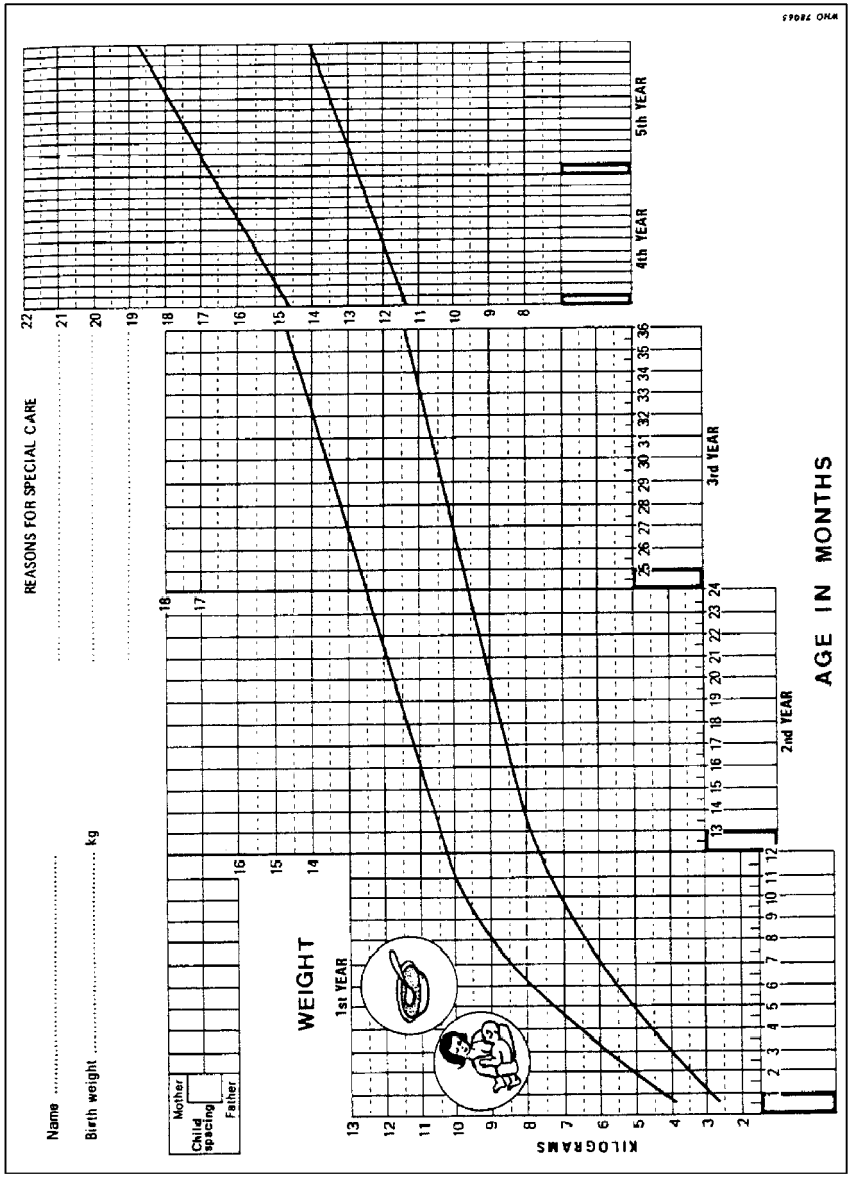

Figure 15: The Growth Chart of the WHO

Appendix 5: The food square

In the Food Square (see figure 16) foods are divided into four groups. If at each meal something from each group is eaten, then it usually means that the nutritional needs have been satisfied.

Group 1 – Staple food

The most important and cheapest energy-giving food source is the staple food. The staple food contains much carbohydrates. Examples of foods in this group are products such as: maize, rice, wheat, potatoes, cassava, sweet potatoes, yam and plantain. They must be supplemented with food from each group of the food square.

Group 2 – Protein

Food in this group contains all the protein supplements.
They include products such as: beans, peas, leaf vegetables, other vegetables and fruit.

Group 3 – Vitamins and minerals

This group comprises all the vitamins and mineral supplements. The products include: leaf vegetables. other vegetables and fruit.

Group 4 – Fats

In this group are all the extra energy supplements. These products include: red palm oil, oil, peanut oil, butter, margarine, sesame seed, coconut cream and sugar.

Breast-feeding must be continued as supplement for as long as it is possible, because it offers good complementary foods.

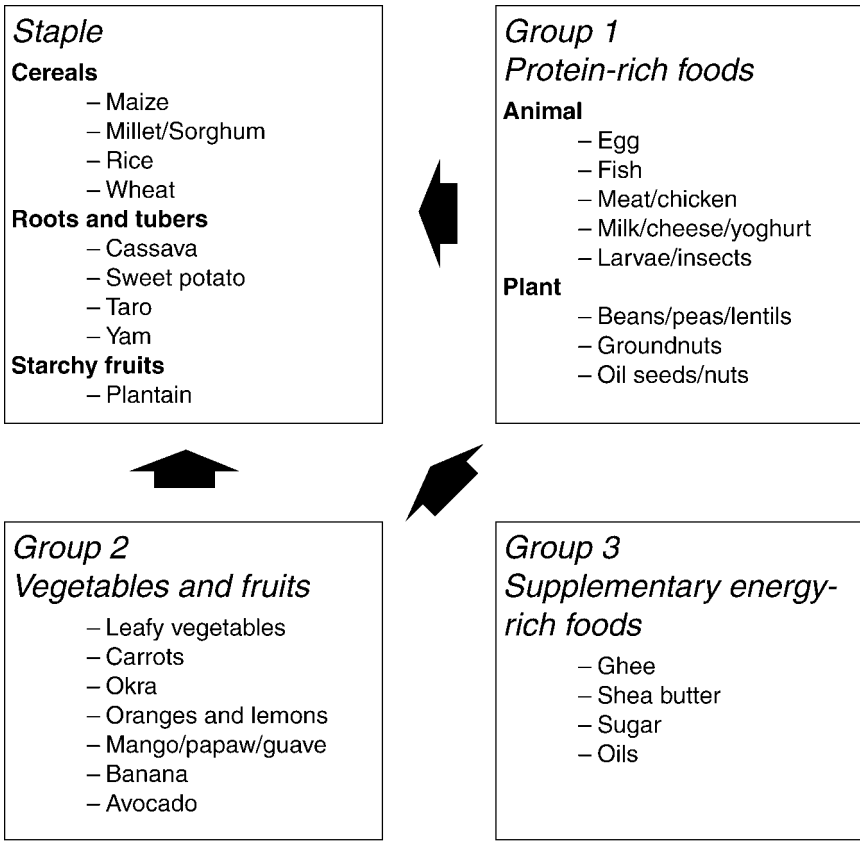

Figure 16: The Food square

Further reading

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WHO, **The growth chart - a tool for use in infant and child health care**. 1986, WHO, Geneva, Switzerland.

Useful addresses

A number of newsletters on nutrition and health care are published free of charge for people in developing countries. A subscription can be obtained from the organizations below:

'ARI news', 'Dialogue on Diarrhoea', 'Health Action'
AHRTAG (Appropriate Health Resources and Technology Action Group)
1 London Bridge, London SE1 9SG, UK.

'Breast feeding Briefs'
Geneva Infant Feeding Association
Box 157, 1211 Geneva 19, Switzerland.

'IDD Newsletter'
International Council for Control of Iodine Deficiency Disorders
Box 511, University of Virginia Medical Centre,
Charlottesville, VA 22908, USA

'Mothers and Children'
Clearing House on Infant Feeding and Maternal Nutrition
American Public Health Association
1015 15th ST. NW, Washington DC, 20005, USA.

'TALC newsletter' and lists of books, slides and accessories
TALC (Teaching Aids at Low Cost)
Box 49, St Albans, AL1 4AX, UK.