

Weight increase in toddler children in the Federation of Malaya: a comparison of dietary supplements of skim milk and fish biscuits

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In the Far East, where most children receive an inadequate amount of protein in the diet, it has been found that the addition of even a small amount of protein benefits the child and improves its health. In Malaya the daily total protein intake of children falls well below the recommended allowances for the various age groups. Only in exceptional circumstances is there absolute starvation, but nearly half the children show some signs of protein-calorie malnutrition, and kwashiorkor is not uncommon (Thomson, 1954, 1958; Said, 1955; Dean, 1959).

Soil and climatic conditions in Malaya are such that pulse crops, groundnuts and soya beans, need more care in cultivation than do root and leaf vegetables. The acreage under pulses is small. Both groundnuts and soya beans are, however, familiar items of diet, and amounts adequate for the present needs of the country are imported. It is expected that with increased interest in rural development more pulse crops will be grown. Total production of fish has increased more than 100% in the last few years, owing partly to the introduction of improved methods and gear for deep-sea and off-shore fishing, and partly to an increase of freshwater fish farming in the inland rural areas.

It appears, therefore, that the use of fish or fish meal, either alone or in combination with vegetable-protein preparations, deserves serious consideration for any supplementary feeding scheme in Malaya. One of the more important reasons for supporting the use of fish is its relatively high lysine content, since lysine is the limiting amino acid in the traditional rice diet. The production costs of fish meal and of vegetable-protein mixtures prepared from indigenous materials are about the same.

Dean (1956) and Venkatachalam, Srikantia, Mehta & Gopalan (1956) and others have demonstrated improvement of health in children receiving vegetable-protein mixtures. The Indian multi-purpose food (MPF) developed by Subrahmanyam and his colleagues at the Central Food Technological Research Institute, Mysore (Subrahmanyam, Doraiswamy, Joseph, Narayanarao & Swaminathan, 1957; Karnad, 1960), and the mixture now known as 'incaparina' developed by Scrimshaw and his colleagues at the Institute of Nutrition for Central America and Panama (INCAP) deserve special mention. The careful work leading up to the final production of 'incaparina' is admirably summarized in *Nutrition Reviews* (Anonymous, 1960).

Dean (1953) points out that the value of fish in animal feeding is established, and

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considers that it should be easy to find some preparation of fish suitable for children. In a later publication (Dean, 1957) he includes fish meal among the foods which might be more extensively used in human dietaries. More recently Arétas (1959) and Sénécal, Aubry, Dupin & Moreigne (1960) have reported the results of trials in Senegal with a fish biscuit, prepared from vegetable and fish proteins.

The only supplementary food available in any quantity in Malaya is UNICEF skim-milk powder; it is distributed to pregnant and lactating women, and to children up to the age of 5 years, at maternal and child health centres. In mid-1960 a sample of tunny fish meal was obtained from a local factory. The production of a supplementary food, either fish meal alone or in combination with vegetable proteins, then became a practical possibility; trials of such foods were considered to be urgent since the UNICEF skim-milk supply is intended to be only temporary, and recipient countries are encouraged to develop their own protein-rich supplements. A small gift of fish meal, prepared in Thailand, was made available by UNICEF through the good offices of the FAO Regional Nutrition Officer in Bangkok. At the same time a gift consignment of fish biscuits, very similar in composition to those used in Senegal, was received. Preparation of tunny fish meal in the local factory was not yet standardized, and the product had too high a bacterial count for use in feeding trials. Nevertheless, it was considered desirable that palatability trials of fish meal and of fish biscuits should be carried out, and that experiments designed to compare the weight increase of toddler children receiving at least one supplement containing fish, with the increase in children receiving skim milk, should be begun. There was insufficient fish meal for use in more than palatability trials, but enough fish biscuits to supplement the diet of about forty children for 1 month. This investigation therefore deals with palatability trials of both fish meal and fish biscuits, but with fish biscuits alone in the comparison of weight gains.

EXPERIMENTAL

General

The fish biscuits were composed of a mixture of 12% millet flour, 25% sugar, 20–24% groundnut press-cake flour, and 12–14% deodorized fish meal: the fish used was *Clupea pilchardus*, which is very similar to a local Malayan fish, *ikan tambun* (*Sardinella clupea*). The protein content of the biscuits was 24%, the fat content 10–13%, and the moisture 5%. The lysine content of the final biscuit, which was prepared under carefully controlled conditions, was standardized to 3.5%. A little lemon flavouring was added to the biscuits for palatability.

The taste of fish meal presents no drawback in a country where strong-tasting fish dishes are served in every home. Deodorized fish meal, as a separate article of food, has not been tested in Malaya, but its use may become advisable because of the inherent difficulties of producing a satisfactorily hygienic fish meal simply by pressing and drying the fish flesh. The danger of possible toxic residues left in the deodorized product may be less than the danger of contamination in the plain dried meal. The fish biscuits supplied, although prepared from deodorized fish meal, had a distinctly 'fishy' flavour to the adult palate.

All the children concerned, both in the palatability trials and in the experiment on weight gain, were living in their own homes and attending maternal and child health centres. Various simple preparations of the three supplements were used in the palatability trials, and the method of voluntary supplementation was used in the experiment which followed.

Preliminary palatability trial

Skim milk. Skim milk is now a familiar food in Malaya, largely acceptable to the people. It therefore needed no further trials. It is eaten by the children as a powder mashed either with banana or with cooked sweet potato. This method is better than making a milk drink, which is an unfamiliar item of diet for small children in Malaya.

Fish meal. Fish meal was tested at seven different clinics; several hundred children of the three main races, Malay, Chinese and Indian, were given the meal to taste. Five of the clinics were Malayan Government Maternal and Child Health Centres, where trained Health Nurses are in charge; the two other clinics, one army and one police, were under the charge of Soldiers', Sailors' and Airmen's Families Association (SSAFA) sisters.

As children came in for examination by the nursing staff both mother and child were given some of the fish meal to taste. It was given dry in a spoon straight from the tin, first to the mother, in order to give the child confidence, and then to the child. Children ranged in age from about 10 months to 5 years. The mother's usual comment was, at once, 'Yes, good, like *ikan bilis*'. *Ikan bilis* is a small dried salted fish (white-bait, *Stomateus* sp.) used in most Malayan homes. In other words the food was acceptable and of a familiar flavour.

Some fish meal was also left with the sister in charge who, on another day, made some demonstration dishes. The meal, mixed with soft cooked rice, was liked. Salt was not added and there was comment that a little salt would improve the flavour. The meal was also added to a vegetable soup; this, too, was well taken. It was established that children of all races liked fish meal.

Fish biscuits. Fish biscuits were tested for acceptability at the same seven clinics. Several hundred children of all three races were given the biscuits to taste, and were observed eating them. Other children were supplied with a few biscuits for trial at home. There was no adverse criticism, in fact children usually asked for more. Mothers, however, made the sensible comment: 'What is the use of the child developing a taste for the biscuits when they are not generally available in the shops, or as a free issue?' Adults did not care for the biscuits because of their sweet flavour, but children enjoyed the sweet fishy taste. This was all to the good, as children were more certain of receiving their supplement. Mothers found the biscuits a most convenient type of meal since no cooking is necessary. Nearly all children enjoyed eating the biscuits plain, but some liked them crumbled over a plate of rice, or mixed into soft-cooked rice. It was established that children of all races liked fish biscuits.

The choice of children for feeding trials with skim milk and fish biscuits was then begun.

Experiment on weight gain

Supplements. The fish biscuits and the skim-milk powder were used as supplements to the normal home diet. Children receiving skim milk were given 8 oz of the powder each week for 4 weeks, this representing a supplement of just over 80 g protein/week. Children receiving the fish biscuits were given fourteen biscuits each week for 4 weeks, a supplement of a little less than 70 g protein/week. Control children received their normal home diet without additions.

Subjects. Children were chosen, as far as possible, from among the 2- to 4-year-olds attending five different maternal and child health centres. During these years the child is in greatest need of a protein supplement and also should show a steady gain in weight. Racial groups were not separated owing to the small numbers involved; Malays predominated in all three groups, but in each group there were a few Chinese and one Indian. All children were in reasonably good health; results for those who developed any sickness during the 4-week trial period were excluded from the final calculations. Some difficulty was experienced in keeping strictly to the chosen age group owing to the large number of defaulters.

Weighing. All children were weighed at the beginning and the end of the 4-week period, but most were weighed weekly as a check on the reliability of the mother and also to ensure that the child was in good health. Children were weighed in their clothes, but care was taken to see that the number and type of garments did not vary from week to week. All weighings of any one child were made on the same weighing machine; minor variations between weighing machines in the different clinics were not taken into account since only the difference in weights was to be considered.

RESULTS

Forty-seven children (twenty-five boys and twenty-two girls) completed the month's trial satisfactorily. They were one 5-year-old, eight aged between 12 and 18 months, and thirty-eight between 2 and 4 years old. There were thirteen children (six boys and seven girls) in the control group. Another thirteen (nine boys and four girls) had received skim milk, and twenty-one (ten boys and eleven girls) had received fish biscuits.

The initial weights of all children fell within the generally accepted Malayan limits for their age and sex (Millis, 1957, 1958; Thomson, 1961), and an analysis of variance showed that no significant difference could be established between the initial mean weights of the children in the three groups. Table 1 shows that the weights of these children were, with few exceptions, well below those expected in the United Kingdom (Ellis, 1956).

Table 2 shows the mean weight increases in 1 month for each sex and for all children in all three groups. Boys in the control group showed a mean weight gain of 6.3 oz compared with mean gains of 11.7 and 29.4 oz for the skim-milk and fish-biscuit groups respectively. Girls in the control group showed a mean weight gain of 12.0 oz, nearly double that of the control boys; gains for girls in the skim-milk and

fish-biscuit groups, respectively, were 18.0 and 21.2 oz. Thus girls apparently showed a better weight gain than boys with skim milk (but the number in this group was very small) and the weight gain for girls in the fish-biscuit group (in which the numbers of girls and boys were nearly the same) was less than that for boys.

Table 1. *Initial weights (lb) of boys and girls in all three groups in Malaya compared with weights of children in the United Kingdom*

Age (years)	No.	Malaya		UK (Ellis, 1956)
		Range	Mean with standard deviation	Mean with standard deviation
Boys				
1	4	16.00-24.25	20.73 ± 3.72	22.75 ± 2.38
1½	1	(19.75)	(19.75)	—
2	7	18.75-23.69	20.88 ± 1.84	27.76 ± 3.23
2½	2	20.00-22.50	21.25 ± 1.77	29.89 ± 3.55
3	5	19.38-27.38	22.30 ± 3.33	32.21 ± 4.12
3½	3	23.31-30.00	25.77 ± 3.64	34.69 ± 4.67
4	2	27.00-29.00	28.00 ± 1.42	36.75 ± 4.99
4½	—	—	—	38.94 ± 5.12
5	1	(40.00)	(40.00)	41.05 ± 5.85
Girls				
1	2	16.00-18.00	17.00 ± 1.42	21.69 ± 2.38
1½	1	(27.00)	(27.00)	—
2	6	18.00-26.75	22.22 ± 2.86	26.14 ± 3.40
2½	2	19.38-28.06	23.72 ± 6.14	28.62 ± 3.55
3	8	19.38-34.00	25.99 ± 4.85	31.02 ± 4.13
3½	1	(28.00)	(28.00)	33.21 ± 4.28
4	1	(29.00)	(29.00)	35.60 ± 5.04
4½	1	(41.50)	(41.50)	37.68 ± 5.24
5	—	—	—	39.78 ± 5.71

Table 2. *Weight increase (oz) in 1 month of toddler children in Malaya receiving supplements of fish biscuits or skim milk compared with a control group of children receiving no supplement*

Supplement	Boys		Girls		All children	
	No.	Mean with its standard error	No.	Mean with its standard error	No.	Mean with its standard error
None	6	6.3 ± 3.7	7	12.0 ± 3.4	13	9.4 ± 2.5
Skim milk	9	11.7 ± 3.0	4	18.0 ± 4.5	13	13.6 ± 2.5
Fish biscuit	10	29.4 ± 2.9	11	21.2 ± 2.7	21	25.1 ± 1.9
Total	25	17.5 ± 1.8	22	17.7 ± 1.9	47	17.6 ± 1.3

Analysis of variance for weight increases in boys and girls shows that the weight increase of boys receiving fish biscuits was significantly greater than that of boys receiving skim milk ($P < 0.001$) and this increase in turn was numerically (not at significance level) greater than that of control boys. For girls, the trend of weight increase was similar to that for the boys, but no significant difference was established.

When all the children were considered together, the mean weight gain for control children was 9.4 oz, that for children receiving skim milk 13.6 oz, and for children

receiving fish biscuits 25.1 oz. The weight increase for children receiving fish biscuits was significantly greater than that for children receiving skim milk ($P < 0.001$), which in turn was only numerically greater than the weight increase for the control group. The weight increases of girls in the control and skim-milk groups, although greater than those of the boys in these groups, were not significantly so; neither was the weight increase of boys in the fish-biscuit group significantly greater than that of girls in that group.

DISCUSSION

Children over the age of 2 years grow at a slower rate than younger children. Normal growth in English children between the ages of 2 and 4 years is at the rate of about 6 oz a month (Ellis, 1956). In tropical countries the growth rate in this age group is more erratic, as the child tries to adjust himself to the part of the adult diet that custom allows (Dean, 1957, 1959; Thomson, 1960) and is exposed to the numerous hazards of minor ill-health affecting all children in that age group, as well as to the endemic tropical diseases of his homeland. The weight increase in Malayan children between the ages of 2 and 4 is usually between 4 and 5 oz a month (Millis, 1957, 1958; Thomson, 1961), varying noticeably with race and social status.

In our experiment most children were in the desired 2- to 4-year age group, but there were also eight children aged between 1 year and 18 months; six of these smaller children were in the group receiving skim milk, and it was feared that the rate of gain in weight in that group might be increased by the inclusion of these younger children; it was not found to be so.

The mean weight increase of 9.4 oz for children in the control group was noticeably higher than expected. Children in this group were, however, carefully selected to include only those who were not in need of any supplement, and some of them were the offspring of Health Department staff.

Most Malayan children are underweight compared with children in western countries, and the children in this experiment were no exception, as is shown in Table 1. The low initial weights suggest that an exaggerated response to the supplements might be expected. The parents were well aware that an experiment was in progress, and it is therefore possible that children in the control group showed these unexpectedly increased gains in weight because of additional interest taken by parents in the composition and preparation of meals.

The skim-milk supplement provided each child with at least 10 g a week more protein than the supplement of fish biscuits. Skim-milk is normally issued in 8 oz packets, and fish biscuits are conveniently issued at the rate of two per child per day. Even with the slightly lower allowance of additional protein the children in the fish-biscuit group showed superior weight gains.

Table 3 shows the calorie values and the protein, fat, and calcium contents of the daily supplements, and gives figures for mean daily intakes/head found in two surveys in rural areas in Malaya (Thomson, 1960).

Toddler children would, in general, have a lower intake of protein than the older members of the family, since many dishes are withheld from them as being unsuitable

for one reason or another. They are likely, on the other hand, to receive a fair share of all carbohydrate foods. It seems improbable, therefore, that the greater calorie value of the fish-biscuit supplement was responsible for the increased gain in weight in that group. The higher fat content of the fish biscuits may, however, have some significance.

Three factors, all likely to cause a less favourable result in children receiving fish biscuits in comparison with the other groups, have been mentioned. The control children were remarkably healthy, and some of them may have been of slightly higher social status than the children in the experimental groups; the majority of the younger and faster-growing children were in the skim-milk group; and finally the protein supplement in the skim-milk group was greater than in the fish-biscuit group. There remain two factors that must be considered as in favour of the fish-biscuit group: the first is the relatively higher lysine content of the fish-biscuit supplement and the other is the favourable reaction, both of children and their mothers, to the fish biscuits.

Table 3. *Daily contribution of skim-milk and fish-biscuit supplements to the intake of calories, protein, fat and calcium by the children, and mean daily per head intakes of these nutrients in two rural areas in Malaya*

	Calories (kcal)	Protein (g)	Fat (g)	Calcium (mg)
Skim milk (32.4 g)	117	11.5	0.3	421
Fish biscuits (40 g)	167	9.6	4.0-5.2	128
Mean total intake:* (1)	1812	49	23	570
(2)	1630	47	30	550

* Thomson (1960); (1) Parit, Perak; (2) Alai, Malacca.

The lysine content of the fish biscuits was standardized to 3.5% of the final biscuit, giving each child about 1.4 g lysine daily, whereas the children on the skim-milk supplement would have received a little over 0.9 g (Harvey, 1956). Clegg (1960) mentions some of the difficulties she encountered in avoiding loss of lysine when preparing supplementary foods containing mixtures of vegetable and animal protein, the animal protein source being skim-milk powder. The manufacturers of the fish biscuits have achieved, after trial, a method of mixing the constituents of their product so as to avoid excessive loss of lysine; the similar biscuits used by Arétas (1959) and Sénécal *et al.* (1960) in Africa were not baked, but compressed without cooking. The superior lysine content of the fish-biscuit supplement may have had a more beneficial effect on the growth of these Malayan toddlers, whose main daily meals normally consisted only of rice with a little sauce for flavouring.

The acceptability of the fish biscuit as a supplementary food was amply demonstrated in the palatability trials. Sai (1960) lists the requirements of a protein supplement, and the fish biscuits would appear to fulfil most, if not all, of them. Skim milk, although now generally accepted as a supplementary food in Malaya, does not store very easily and must be mixed into some dish before being given to the child. The Malayan toddler does not always sit down to his meals; he is given some food, either in his hand or on a plate, and may walk about near the house or sit in the doorway to eat. The fish biscuit has obvious advantages over skim milk in ease of use.

The different behaviour of boys and girls in this experiment is difficult to explain; although girls in the control and skim-milk groups showed a greater increase of weight than boys in those groups, the greater weight increase of boys in the fish-biscuit group runs counter to this trend. Boys tend to receive preferential treatment in the home because of their sex and it may be that boys were allowed to discard parts of meals that were relatively unpalatable to them, such as some of the skim-milk dishes, and also that male siblings of some of the girls in the experimental group were allowed to share some of the fish-biscuit ration.

The results of another trial made somewhat later with rather older children in a residential school are worth reporting. The forty youngest of the 120 children in the school (eleven boys and twenty-nine girls, nearly all between 6 and 8, with an average age of 7) were given one fish biscuit each at midday, and again in the evening, in addition to their regular meals. The school diet supplies 1361 kcal/head daily (62% of the recommended allowance of the (U.S.A.) National Research Council: Food and Nutrition Board (1958), modified for Malayan climate and body size). The total protein supply was 50 g/head daily; 9 g was contributed by meat, fish or eggs, 15 g by skim-milk powder, and 26 g were of vegetable origin. The mean weight with its standard error of the eleven boys (eight Malays and three Chinese) at the beginning of the 4-week trial was 40.1 lb \pm 2.1; the mean gain in weight in 4 weeks was 2.3 lb \pm 0.5. The mean weight of the twenty-nine girls (twelve Malays, sixteen Chinese and one Indian) was 42.1 lb \pm 0.9; the mean gain in weight was 2.1 lb \pm 0.2. Statistical analysis of these results showed that there was no significant difference between the initial weights of boys and girls, nor could any significant difference be established between the weight gain of boys and girls. The Principal of the school reported that all children relished the fish biscuits and ate their full ration; adults found the biscuits unacceptable. These children were already receiving a 15 g protein supplement from skim-milk powder, but the additional 10 g supplement from the fish biscuits was sufficient to cause a weight gain of nearly four times the normal (5-6 lb/year) to be expected in that age group. These children were between 6 and 8 lb lighter than United Kingdom children in the same age group (Ellis, 1956) and some of the more underweight among them showed gains of 4-6 lb in the 4-week trial period. The similar behaviour of boys and girls in this second trial suggests that the toddler boys in the earlier experiment, when supplementation was voluntary, may have received preferential treatment in the home.

SUMMARY

1. Supplementary foods to replace skim-milk powder are needed in Malaya. Foods of vegetable origin rich in protein are not widely grown, but supplies of fish are increasing.
2. Trials of fish meal and a commercially prepared fish biscuit showed that Malayan children and their mothers found them acceptable.
3. Weight gains during 1 month of three groups of toddler children were compared. Thirteen received skim-milk powder, twenty-one fish biscuits, and thirteen were healthy controls. Supplements were taken on a voluntary basis.

4. The children receiving the fish biscuit showed a greater increase in weight than those receiving skim-milk powder and the controls. It is suggested that the higher lysine content of the biscuits, and their convenience in use, contributed to this result.

5. The results of a further trial with slightly older children are briefly reported. They showed that children given fish biscuits as a supplement to a diet already containing skim milk showed greater increase in weight than children receiving the diet supplemented by skim milk alone.

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