Effect of Soybean fortified food on Anthropometric variables of Protein -Energy Malnourished (PEM) Children

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Abstract

Sixteen children between the age of 12-14 months with signs of severe protein-energy malnutrition at Oni Memorial hospital at Ibadan, Nigeria was selected for this study.

Soyflour incorporated into some staple foods, soygari and soymilk were fed to the children ad labium for 8 weeks in admission and on weekly basis after discharged. Mineral and vitamin tablets were given as supplements.

Anthropometric measurements (weight, height, chest, head and upper arm circumferences as well as skinfold measurements) were obtained before treatment and on weekly basis for eight weeks. The 3rd centile of reference population (WHO, 1983) was chosen as cut off point.

Results of the chemical analysis show that soybean fortified foods are high in protein content (3.70-49.9%). Before soybean diet administration, the mean weight of the children was below the 3rd centile of medium weight for age reference population. However, after 8 weeks, mean weight was 9.1 kg and rose to between 5th and 10th centile reference population. Height and head measurement were not significantly ($P < 0.05$) affected by the treatment. Other anthropometric variables were significantly improved after treatment. Clinical signs of PEM also disappeared after 8 weeks of treatment with soybean.

There were variations in the individual child response to soybean fortified food treatment.

Introduction

Protein-Energy Malnutrition (PEM) is caused by an inadequate intake of energy and protein over a period of time and may severely affect the growth of an individual. The most vulnerable group of individual are children who are weaned on starchy foods (Akobundu and Hoskins, 1987). It has been reported that in some parts of Africa that up to 50% of children die before the age of 5 years and about 70% of these children suffer from PEM (Oke et. al., 1984)

Anthropometric measurements such as weight, height, circumferences of the head and arm, and skinfold thickness are considered good indicators of nutritional status for growing children (Loewenstein and Phillips, 1973) and can be used to identify individuals whose nutrition should be improved.

A dietary treatment of children with kwashiokor was done by Reddy and Gupta (1974) using Opaque-2 maize or kim milk diet with multivitamin tablets plementation. Their result indicated both clinical (wrinkled skin, oedema d biological (packed cell volume Haemoglobin HB), responses in children who consumed the s were comparable to those h skim milk. The objective of s to evaluate the effect of soybean fortified food on anthropometric parameters of children with PEM.

Materials and Methods

Sixteen children (8 boys and 8 girls) between the ages of 12-24 months with severe PEM were selected for the study at Oni Memorial Hospital in Ibadan, Nigeria. Children were identified to have severe PEM based on expected height and weight for age deficit according to Waterlow (1973) and were below the third centile for the reference body weight of WHO measurement as contained in Measuring Change in Nutritional Status (MCNS) guidelines of 1983. The selected children also had signs of PEM such as wrinkled skin, oedema, irritability, whining cry and pale eyes.

Feed the Children

The treatment of the PEM children started with the control of infection and introduction of graduated soybean feeds with mineral and vitamin supplements. The quantities of the solid foods were gradually increased as treatment and recovery progress, but still provided the same calorie and protein\Kg\body weight.

Soybean was processed into soygari (Fig. 1) and (Fig. 2) soy flour. The soyflour was incorporated into *ogi*(maize paste), *moinmoin* (steamed grind cowpea), *eko* (steamed maize paste pudding), vegetable soup at a ratio of 3:1. Soygari was consumed by soaking in water or made into *eba* (a pudding made when gari is stirred in boiled water). On admission, the children were provided with soymilk and soyogi fortified with palm oil (5ml to 300ml of soyogi). The children were gradually introduced onto other soybean foods by the middle of the second week. The foods were given ad libitum. Food consumed by each child was measured and average consumption for each child was determined. The quantity of food given to each child was adjusted to give 150Kcal and 3.5g protein per Kg body weight per day. The children were admitted for 8 weeks and visited the clinic on a weekly basis after the eighth week. Series of demonstration on how to incorporate soyflour into the child's food was done in the hospital and a soybean recipe booklet by Institute of Agricultural Research and Training (IAR&T), Ibadan, Nigeria was provided to each of the mothers. In addition to the soy based foods given to the children during the period of study, they also received mineral and vitamin tablets as recommended by the hospital management.

Figure 1. Flow Chart for Processing of Soygari

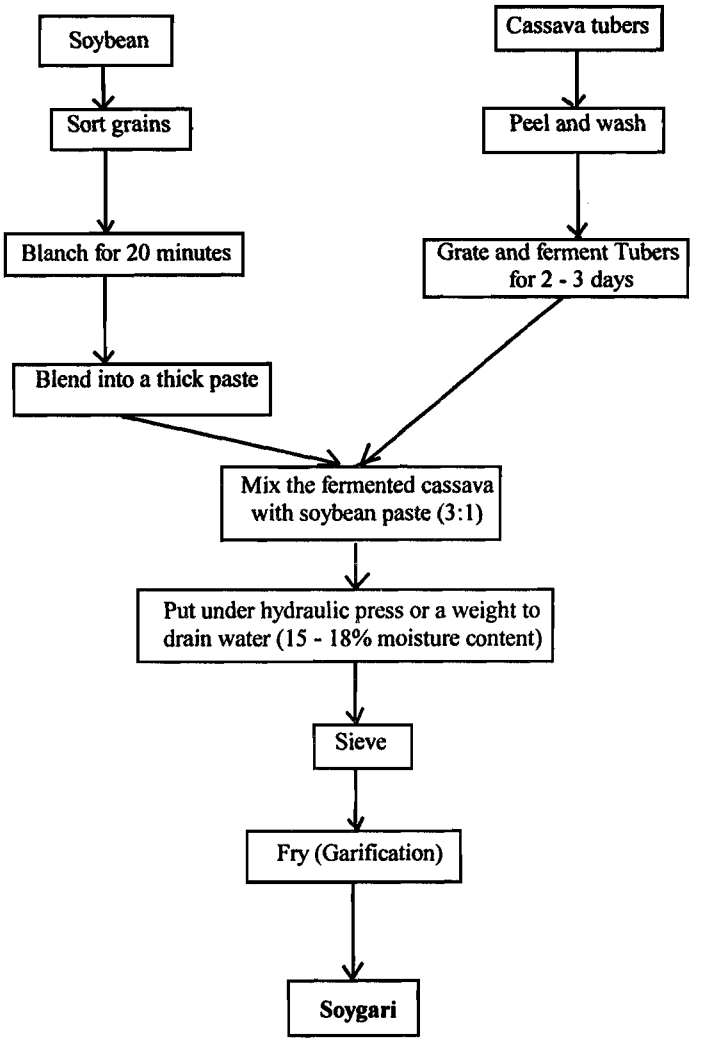
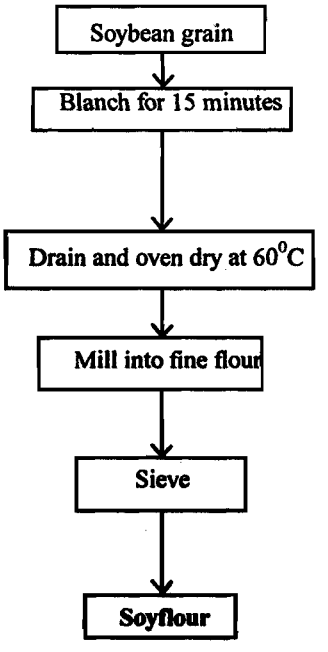


Figure 2: Flow chart for Processing of Soyflour



Chemical Analysis

The products fed to the PEM children were analysed for protein, fat, energy, moisture and mineral (iron, calcium, magnesium and phosphorous) contents. The protein, fat and moisture contents were determined according to the method of Association of Official Analytical Chemist (AOAC, 1985). The energy values of the products were determined with Ballistic bomb calorimeter (Gallenkamp and Co. Ltd).

For the mineral analysis, the samples were digested and analysed according to the method of Juo (1981).

Anthropomentric Measurement

Weight, height, chest, head and upper-arm circumferences and skinfold measurement were obtained at point of admission and on weekly basis for eight weeks by the same person. The chosen cut-off point for measurement was 3rd centile of reference population (WHO, 1983).

Analysis of Data

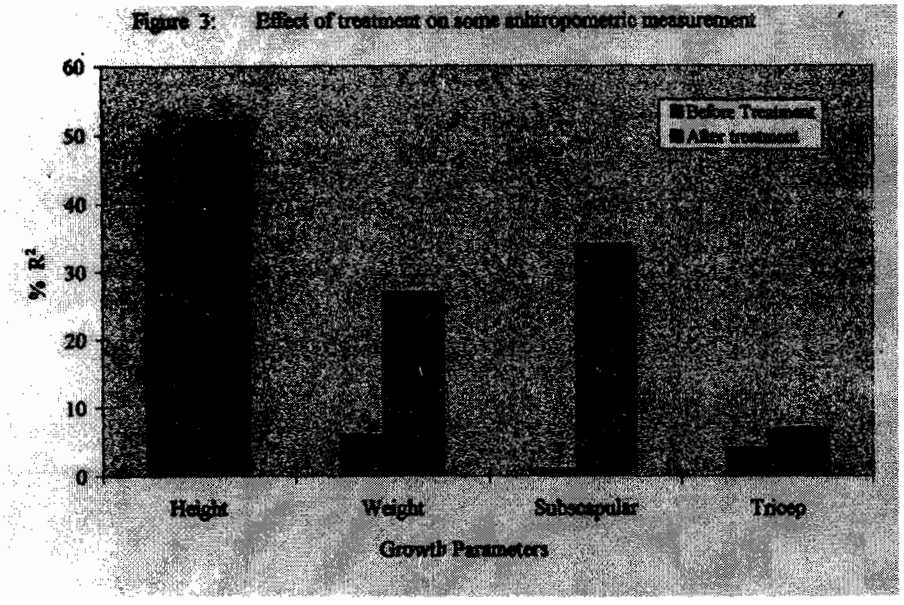
Regression analysis was used to determine the effect of treatment on some of the anthropometric variables, while correlation analysis was done between weeks of treatment and the growth variables.

Results and Discussion

The chemical composition of soy fortified foods given to the children are shown in **Table 1**. The result shows that soybean foods are very high in protein ranging from 3.70% soymilk to 26.3% *soyakara* (fried soybean paste + cowpea paster). This agrees with Bressani and Ellias (1983) that found the protection content of food to increase with the inclusion of soybean.

Anthropometric Measurement

The mean age of children before treatment 17 months with an average weight of 6.2 kg. This average weight was below the 3rd centile of medium weight for age of reference population. The average weight (9.1 kg) obtained for mean age of 19 months after treatment was between the 5th and 10th centile reference population. An indication of nutritional improvement



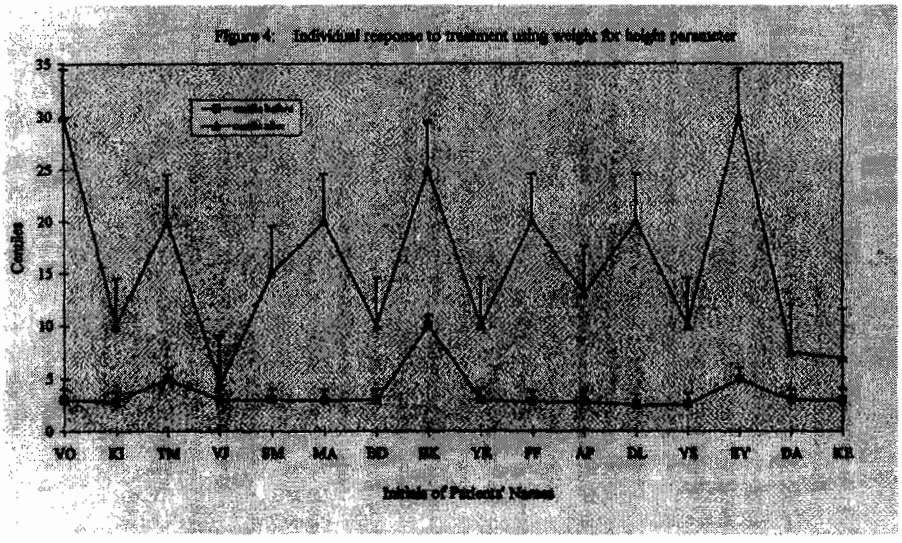


Table 1: Chemical composition of soybean based food (% 100g wet basis)

	Moisture	Protein	Fat	Energy	Fe	Ca	Mg	P
Flour	5.2	47.9	24.2	485.2	0.09	0.10	0.42	0.14
Milk	86.1	3.7	3.2	68.6	0.08	0.03	0.01	0.29
Ogi	76.9	10.8	2.0	214.1	0.06	0.04	0.21	0.12
Eko	68.8	12.8	2.2	147.9	0.06	0.08	0.18	0.14
Moin*	56.8	22.6	10.6	213.8	0.2	0.03	0.14	0.10
Akara	43.6	26.0	24.6	343.9	0.21	0.08	0.20	0.13
Eba	66.8	6.6	2.2	148.2	0.09	0.34	0.18	0.14
Veg.**	64.3	18.6	18.6	241.6	0.12	0.08	0.32	0.23
Gari	7.8	11.0	11.0	381.6	0.09	0.02	0.3	0.17

* Moin - Moinmoin
**Veg. - Vegetable soup

of the treated children. **Table 2** shows that most and 100% of the children were below the 3rd centile for height and weight respectively before treatment with soybean based foods. This was an indication of chronic undernutrition among the studied children. There was however an improvement when fed with soybean based foods (**Table 2**). A similar nutritional improvement was observed by Hung et. al., (1967) in an infant feeding experiment with cereals and soybean using cow milk as control. The weight gained by infants fed on soybean blends was comparable to that achieved by infants fed cow's milk.

Figure 3 depicts the effects of eighth week long treatment of the malnourished children with soybean fortified food on some anthropometric measurements. It was observed that height is not significantly ($P > 0.05$) affected by the treatment as there was only 2% growth in height by the patients to whom soybean fortified food were administered. Several authors have reported that length is only affected during chronic undernutirion which may result in permanent stunting of growth (Seone and Latham, 1971; Waterlow 1972; Alleyne et. al., 1981). However, weight and subscapula measurement were significantly ($P < 0.05$) improved after treatment of children with soybean fortified foods. Thus 21% and 33% increased were recorded for weight and subscapular respectively. A slight but not significant improvement of 3% was recorded for triceps.

The correlation analysis (**Table 3**) shows the rate of growth with period (weeks) of applying soybean fortified foods. The results clearly show that weeks of intake of soybean fortified foods have a positive significant ($P < 0.01$) relationship with all the seven growth variables. The average PEM child increased by 0.05mm and 7g weekly in height and weight respectively. There was a highly significant difference ($P < 0.1\%$) in the triceps, subcapular, chest circumference and weight measurements after treatment agrees with the growth rate of 8 children studied by Ashworth (1969), whose growth exceeded those of normal children until they attained the minimum weight for ages.

The clinical signs shown by the children at the beginning of treatment disappeared

Table 2: Percentage distribution of children by Weight and Height for age centile bracket

Centile Bracket	0.0-2.9		3-4.9		5-9.9		10-19.9		20-29.9		30-39.9		40-49	
Variables	B*	A*	B	A	B	A	B	A	B	A	B	A	B	A
Weight for age	100	25	-	58.3	-	11.3	-	6.3	-	-	-	-	-	-
Height for age	87.5	81.2	6.2	6.3	-	6.3	6.3	-	-	6.3	-	-	-	-

*B - Before treatment
*A - After treatment

Table 3: Correlation analysis between weeks of administration of soybean based food and seven growth variables

Variables	Correlation (r)	Regression (b)	Intercept (a)
Height	0.762	0.0050	0.687
Weight	0.746	0.0070	0.063
Head*	0.055	0.0001	0.119
Chest*	0.429	0.0020	0.085
Upper-arm*	0.933	0.0050	0.039
Triceps	0.307	0.0011	0.014
Subscapular	0.526	0.0042	0.002

* Circumference

after the treatment. This confirmed the result of Hung et. al., (1967) who successfully fed infants with full fat soybean rice foods. This group of children gained weight at the rate expected of children within their age group.

Figure 4 shows individual response to treatment using weight for height - parameter. Child number one (girl) moved from below 3rd centile bracket before treatment to 30th centile after treatment while child number one (boy) moved from 5th centile before treatment to 20th centile after treatment. The variation according to Alleyne et. al., (1981) showed the ability of the child to absorb an intake of energy in excess of his maintenance requirement and consequently recover at a fast rate.

Conclusion

The addition of soybean into foods used in the treatment of PEM children improved the nutrient content especially protein of the traditional foods. There was also indications from the result obtained that soybean fortified foods have positive effect on the anthropometric parameters especially weight and skinfold thickness as shown by triceps, subscapular and upper-arm circumference measurements.

Fortification of local food materials with soybean will therefore go a long way in reducing and correcting incidences PEM amongst children of poor parents who can not afford the cost of animal source of protein.

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