

# Effect of Spirulina (Candies) Supplementation on Pre-School Children

R. Varalakshmi<sup>1</sup>, Anangamathi E<sup>2</sup>

<sup>1</sup>Professor, Department of Home Science, Sri PadmavathiMahilaVisvaVidyalayam, Tirupati -517502, A.P., India

<sup>2</sup>Department of Home science, Sri PadmavathiMahilaVisvaVidyalayam, Tirupati -517502, A.P., India

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**Abstract:** *There are many nutraceuticals developed in the world as supplements and spirulina is one amongst them, though spirulina has been recognised as nutrient dense nutraceutical and also as a mineral food for therapeutic purposes, the general public are not aware of the existence of spirulina and its health benefits, use it as an animal feed substitution or set out to save the world by incorporating it as an alternative protein source into the meals of undernourished. The present study funded by antenna trust and supported by RASS tirupati a voluntary organisation to supplement spirulina product to the under five children and to conduct an action research project which comprise of 500 preschool children who were assessed pre and post supplementation by the direct methods of nutritional assessment. The period of supplementation was for 6 months. The parameter assessed were Weight, Height and MUAC which has shown a high significance of the study in spirulina (SP) group in comparison to the non spirulina group (NSP).*

**Keywords:** Nutraceuticals, Spirulina. Nutritional assessment, Weight, Height, Mid upper arm circumference (MUAC).

## 1. Introduction

There are many nutraceuticals developed in the world as supplements and spirulina is one amongst them, though spirulina has been recognised as nutrient dense nutraceutical and also as a mineral food for therapeutic purposes, the general public are not aware of the existence of spirulina and its health benefits. It may be due to lack of knowledge, inadequate awareness about the existing products and interventions for preventing diseases and management of complications.

## 2. Literature Survey

Research and development on spirulina production started in India by 1977. Even though, pilot capabilities were achieved in 1980, and further developmental works were delayed due to investor perception of spirulina as a futuristic product. Commercial production was started in 1944 and at present there are many major producers of spirulina in India. Spirulina is marketed in India mainly as formulated products like tablets and capsules by several pharmaceutical companies (Thomas 1997). The therapeutic applications, which have shown the beneficial effects include mainly metabolic disorders/diseases, like diabetes, hypercholesterolemia, hepatitis, constipation etc. chemo-preventive aspects of spirulina include mainly cancer prevention (carotenes have cancer preventing properties), nutritional blindness. Spirulina has been successfully used as additional source of protein in poultry, pisciculture and livestock, to promote growth. Spirulina is also a well-known name in the herbal medicines and cosmetics. Algae baths are a fast catching-up, nature cure treatments in the west. (Muratee, 1993).

## 3. Method

### 3.1 Objective

To bring comparative research results on the effectiveness of Spirulina on Pre-school children.

#### 3.1.1 Selection of the Study Area and Size of the Sample

A total of 500 children from the RASS adopted anganwaadi centres from chittoor district of Andhra Pradesh (India) were selected to conduct the present study. The sample was further distributed as experimental (250-Sp) and control group (250-NSP). The sample adopted is a purposive random sampling irrespective of their nutritional status.

#### 3.1.2 Pilot study

A pilot study was conducted on 100 preschool children for the acceptability of the product, by supplementing the children with indifferent food products as ground cakes, puffed rice balls and chocolates, the high acceptance was found on the consumption of candies because of its sweet nature and the fascination of children for candies. The Action Research project consists of two phases one is Intervention phase and the other is a counselling phase.

**In intervention phase** 1gm of spirulina fortified candies were distributed to 250 children and candies without spirulina are distributed to the other 250 children. Distribution of candies was administered with the help of anganwaadi worker in each village. There was continuous monitoring in distributing the candies to the children by the research and project assistants. The children have undergone de-worming before supplementation under the supervision of a Medical officer of their respective PHCs.

#### 3.1.3 Counselling Phase

It has Two phases of counselling sessions were implemented to educate the mothers of 500 preschool children and the Anganwaadi workers to create awareness on the product as

basic food groups, Macro and micro nutrients, child nutrition, deficiency diseases, sanitation and hygiene. The concept and benefits of spirulina were discussed with the Anganwadi teachers and they were mobilised and sensitised that how spirulina candies would affect the child's growth. With the help of teachers, the distribution of candies and growth monitoring charts were practicable.



**Figure 1:** Nutrition counselling programme to mothers of children

**Anthropometric Method** approaches are most universally applicable and relatively non-invasive methods that assess the size or body composition of an individual. The parameters weight, height and MUAC were used. In children, growth charts have been developed to allow researchers and clinicians to assess weight-and height-for-age, as well as weight-for-height. For children, low height-for-age is considered stunting, while low weight-for-height indicates wasting. In addition to weight and height, measures of mid-arm circumference used to estimate fat and muscle mass. The WHO (2006) reference standards were used to interpret these measures for grading the children.

**Statistical analysis** Paired t-test and Independent sample t-test were used to analyse the data and to differentiate between the spirulina and Non spirulina group and to know the significance of the study.

#### 4. Results and Discussion

Growth of preschool children who were supplemented with Spirulina candies has shown a marked improvement in their weights than the other parameters. The government of India has accepted the use of WHO standards for the assessment of nutritional status of preschool children and the growth charts are widely being used in health services and Integrated Child Development Scheme.

To assess the prevalence of Malnutrition status weight for age is an widely used indicator for the detection and monitoring of under nutrition and this is the parameter where wide range of results are being expected and the improvement is possible with the help of therapeutic supplementation. According to the WHO standards children fall below -3SD are considered as severely malnourished, have severely stunted growth or with severe muscle wasting. In the present study 62% of the children both male and female were above -2SD and are less than are equal to the median values and are in normal conditions and a 38 per cent of children were in moderate and severely undernourished conditions according to their weight for age.

With the effect of spirulina candies the children have moved from moderate to normal conditions and all the children have moved from severely malnourished to moderate and normal conditions. Stunted children may never regain the height lost but substantially in this study after the supplementation of Spirulina candies there was a noticeable improvement in the height of the children initially 131 children were under moderate nutrition which has decreased to 111. Where as in the control group there wasn't any marked improvement. The children under these circumstances with stunting and wasting have a higher weight gain when receiving a therapeutic diet compared to other diets which results in faster recovery (WHO).

The arm circumference increase from birth to one year from 11 cm to 16 cm and remains fairly constant at about 16 to 17 cm among well-nourished children as the fat of early infancy is replaced by muscle. According to the WHO cut-off point's children who's MUAC is less than 115 mm are recommended as independent diagnostic criteria for severe acute malnutrition. And a measurement of less than 12.5 cm indicates that a child is suffering from moderate acute malnutrition. Accelerated muscle degradation is the primary cause of muscle wasting which is due to inadequate intake of protein and reduced protein synthesis and is characterized by unintentional loss of body weight. When using the WHO standards to identify MUAC of the children of the present study 53 children in spirulina and 62 children in non spirulina were moderately malnourished and subsequently no child was under -3SD or under 12.5cm of MUAC which is considered as severely malnourished and need to be hospitalised, and there wasn't any association found between the Weight for Height and MUAC.

**Table 1:** Comparison between Experimental and control group before and after supplementation according to their weights

Group	Supplementation	Mean (Wt)	SD	N	t-value
Exp (Sp)	Before	11.7736	1.97	250	84.314**
	After	13.9084	1.69	250	
Control (NSP)	Before	12.3028	2.06	250	1.6546
	After	12.9896	6.79	250	

**Table 2:** Comparison between Experimental and control group after supplementation according to their weights

Group	Mean	Sd	N	t-value
SP	13.9084	1.69	250	2.0744*
NSP	12.9896	6.79	250	

The above table-1 elicit that in Spirulina group mean weights of children are increased from 11.77kgs to 13.90kg within 6 months. In Non Spirulina group the mean weights are 12.30kgs and 12.98kgs before and after supplementation respectively irrespective of the age groups. Paired sample t-test reveals that there is significant increase of 2.13kgs in weights of child before and after supplementation in Spirulina group, but there is no significant change found in Non Spirulina group. With the help of Student's t-test it is evident that there is significant difference between Spirulina and Non Spirulina groups with respect to mean weights observed in post analysis since p-value 0.0385 for the corresponding t-value 2.0744. Weight in Spirulina group is found higher than that of Non Spirulina group. The average weight gain for Pre-school children in 2-6 years is 2 to 2.5

Kg per year but the target could be possible within 6 months with spirulina and all the children almost 90 percent of the children were normal in spirulina experimental group. Hence the p-value shows the high significance of the study.

**Table 3:** Comparison between Experimental and control group before and after supplementation according to their Heights and MUAC

Variable	Group	N	Mean	Std. Dev	t-value
Height	Spirulina	250	90.906	11.11	1.087
	NSP	250	89.910	9.29	
MUAC	Spirulina	250	14.392	0.380	19.947**
	NSP	250	13.760	0.324	

**Table 4:** Comparison between Experimental group before and after supplementation according to their heights and MUAC

Experimental group	Mean	N	Std. Dev	t-value	
Ht	Before	88.68	250	8.332	5.099**
	After	90.906	250	11.1179	
MUAC	Before	13.607	250	.3239	51.241**
	After	14.392	250	.3806	

**Table 5:** Comparison between control group before and after supplementation according to their Heights and MUAC

Control group	Mean	N	Std. Dev	t-value	
Height	Before	89.78	250	9.313	2.500*
	After	89.910	250	9.291	
MUAC	Before	13.607	250	.3226	32.276**
	After	13.760	250	.3247	

The above tables 4 and 5 indicate the t-values and p-Values of Heights, Mid Upper Arm Circumference, of the children from both Spirulina and Non Spirulina groups. The results show the high significance of Spirulina group than Non Spirulina group. The t-values and p-values of both the groups were similar as all the children in both the groups were found normal and has improved substantially. Though the Heights, Mid Upper Arm Circumference were found to be significant in both the groups as children do grow faster naturally at this age but the average mean was higher in spirulina than the Non spirulina group.

## 5. Summary and Conclusions

The present study was conducted among 500 preschool children and their nutritional status was analysed by using one of the direct methods of nutritional assessment. The results of the study elucidate that the children belong to the low socio economic status and with minimum or no education to the mothers, fifty per cent of the children were suffering from either fever cough or cold and more than 80 percent are practicing open defecation and open dumping of the garbage which shows the poor sanitary practices of the subjects.

The children supplemented with spirulina have shown a marked improvement in their Weights and Heights specifically. The rate of morbidity has been decreased with increased appetite, where 1gm of spirulina consists of 70% of protein and flushed with micro nutrients, the digestibility and absorption of the nutrients does improves with the help of spirulina, the immunity of the children also increased post

intervention as no child in the experimental group has observed with cold and cough even during the fall of winter. The study was limited for a period of six months which has moved the severely malnourished children into moderate and normal conditions and normal children have not declined either, when any therapeutic food supplement is included in a child's diet a change in under nourished children is observed more than in any normal child(WHO). This study does prove the significance of spirulina among the pre-schoolers who are the future of the nation depending on the data analysed from the present study it can be advocated that spirulina can be used as a wonder food and will supplement a child's diet to improve and maintain their nutritional status.

## 6. Future Scope of the Study

On the basis of the findings of the study the following suggestions are offered for planning and implementing the programmes and leave a scope for future.

- Encouraging women self-help groups to start spirulina products as an enterprise with help of funding agencies.
- Government should promote spirulina products like candies, chocolates etc on a subsidised rates and distribute this along with midday meal and other supplementary programmes in collaboration with voluntary organisations.
- Research institutions may undertake projects on use of spirulina to produce varieties of products
- Food fortification is one other important aspect where the existing supplementary nutrition feeds can be fortified with spirulina with the help of ICDS.

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### **Author Profile**



**Dr. R. Varalakshmi** is working as Professor, Department of Homescience, SPMVV, Tirupati. She has 25 years of teaching & extension experience and 15 years of research experience. She has papers published with many national and international journals, and is a member of renowned societies as Red Cross, NSI etc. Key areas of interest are Community nutrition and extension education.



**Anangamathi. E** is Project fellow & Research Scholar in Department of Home Science, SPMVV, Tirupati. She is UGC-NET qualified and awarded with UGC meritorious fellowship to pursue Ph. D. She has 2 years of teaching experience and has attended national and international conferences.