

*Full Length Research paper*

# Effect of feeding malted foods on the nutritional status of pregnant women, lactating women and preschool children in Lepakshi Mandal of Ananthapur district, Andhra Pradesh, India

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Information of preschool children (400), pregnant women (100) and lactating women (100) was collected. Anthropometric, hemoglobin, clinical and morbidity assessments were carried out before & after supplementation. Amylase Rich Malted Mixes (ARMs) 2 types (Ragi/Wheat) were formulated and suitable products namely *laddu*, *roti*, *kheer* and *porridge* were prepared using formulated malted mixes. Malting decreased grain length, width, kernel weight (0.45 to 19.0g), volume (0.50 –31.2 ml) and hardness (1.12 to 5.9 kg/cm<sup>2</sup>), thus reduced the bulk density of the malted mixes. Chemical composition revealed that, the significant increase (P<0.05) in fat (2.27 g), carbohydrate (98.0 g) and calorie (396 kcal) content of wheat malted mix. However significant increase was observed in calcium (440 mg), thiamine (0.7 mg) and riboflavin (0.9 mg) content of ragi malted mix. Germinated greengram had significantly higher protein (33.0 g), fibre (11.5 g), iron (8.0 g) and vitamin C (157.8 mg) content. The selected preschool children, pregnant women & lactating women were divided into 3 groups. Group II and III fed with ragi malted mix & wheat malted mix respectively served as the experimental groups and remaining group I served as the control group. Significant increase was observed in weight of preschool children and lactating women after supplementation. Hemoglobin level in pregnant and lactating women significantly increased (P<0.01) after supplementation. Considerable reduction (50%) in the incidence of PEM, vitamin A, B vitamins, vitamin C and iron deficiency symptoms in experimental groups. After supplementation, morbidity rate decreased to 50% both the Group II and III.

**Key words:** Malted foods, chemical composition, physical parameter.

## INTRODUCTION

Malting is the controlled germination followed by controlled drying of the kernels. The main objective of malting is to promote the development of hydrolytic enzymes, which are not present in non-germinated grain (Dewar et al., 1997). Other benefits of the malting process include increased vitamin C content, phosphorus availability, and synthesis of lysine and tryptophan, calcium content (Dulby and Tsai, 1976 and (Sangita and Sarita, 2000). Furthermore, amylases are elaborated and

as a result the viscosity of gelled starch decreases (Brandtzaeg et al., 1981). Malting also includes the inhibition of growth of pathogens through the fermentation process.

Amylase rich food (ARF) is germinated cereal flour, which is extremely rich in the enzyme alpha-amylase. The alpha-amylase cleaves the long carbohydrate chains in the cereal flour into shorter dextrans. It modifies the starch content of the cereals so that they do not thicken and would therefore not require dilutions resulting in enhanced digestibility (Inyang and Idoko, 2006). This remarkable property makes it possible to offer a low viscosity yet high energy dense preparation. Therefore, a

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study was conducted to assess the effect of feeding Amylase Rich Malted Mixes (ARMMs) on the nutritional status of vulnerable groups of population, that is, preschool children, pregnant and lactating women in backward and remote villages of a Lepakshi mandal, Ananthapur district, Andhra Pradesh, India.

## MATERIALS AND METHODS

In Ananthapur district 3 mandals namely Hindupur, Parigi and Lepakshi were identified for the study after discussing with local officials. Baseline data was collected in the identified 14 villages from 3 mandals at Ananthapur district using a pretested, structured schedule. After collecting baseline information of the identified villages of 3 mandals, Lepakshi mandal was selected for implementing the study based on the availability of more subjects of low socio economic group with majority of families belonging to schedule caste and schedule tribes. ARMMs of two types (ragi/wheat) were formulated.

Raw ingredients, that is, whole ragi, wheat and greengram were subjected to physical parameters using standard procedures (Kumar et al., 1991) for colour, texture, length, width, kernel weight, kernel volume and hardness in native and malted grains. For the assessment of colour, texture, length and width, an average of 10 whole grains was taken. Proximate composition (moisture, protein, fat, fibre and ash) of whole grains, germinated grains and ARMMs were analyzed (AOAC, 1990). Vitamin C was assessed by colorimetric method (Association of vitamin chemist Inc, 1947). Thiamine was assessed by modified thiochrome method (AOAC, 1990), Riboflavin was assessed by Florescence technique (AOAC, 1990). Minerals such as iron and calcium were determined by atomic absorption spectrophotometer method (AOAC, 1990). Amylase activity was estimated by the standard procedure given by Bernfield (1955). Carbohydrate content was calculated by difference and energy values were computed.

Ragi malted mix was distributed in Siriravam, Gopindevarapally, Tirumaladevarapally and Sadlapally villages, whereas Wheat Malted Mix was distributed in Manempally, Venkatapuram, Gourgampally and Pulamathi Villages.

Individual information of preschool children (400), pregnant women (100) and lactating women (100) was collected on anthropometric, hemoglobin, clinical and morbidity assessments before and after supplementation for a period of 3 months. The purpose of the supplementation was to evaluate the effect of two types of malted mixes (ragi/wheat) on the growth and nutritional status. The selected preschool children, pregnant women and lactating women were divided into 3 groups. Group II fed with ragi malted mix and Group III fed with wheat malted mix served as the experimental groups and remaining group I served as the control group. Permission was obtained from the Director, ICDS project to feed the beneficiaries with ARMMs for a period of 3 months in place of regular RTE food supplied by ICDS.

Anthropometric measurements, which include height and weight of preschool children, pregnant women and lactating women and mid upper arm circumference of preschool children were measured. Clinical observation and morbidity pattern was collected by structured questionnaire developed by Seth et al. (1979). Hemoglobin level of preschool children, pregnant women and lactating women were assessed by Cyanometh hemoglobin method (Dacie and Lewis, 1991). The preschool children were selected based on the degree of malnutrition (<60% to below 90%) as per Gomez classification (Jelliffe, 1966) and pregnant and lactating women were selected with BMI <16 to <20 based on BMI classification (WHO Expert Consultation, 2004).

Clinical symptoms (nutritional deficiency symptoms) of the

selected subjects were recorded before and after supplementation. Nutritional deficiency symptoms such as protein energy malnutrition (PEM), Vitamin 'A' deficiency, Vitamin 'D' deficiency, 'B' complex vitamins deficiencies, Vitamin 'C' deficiency, iodine deficiency and iron deficiency was observed.

## RESULTS AND DISCUSSION

### Physical parameters of native and malted grains

Native and malted grains (ragi, wheat and greengram) were assessed for the physical parameters. The results are given in Table 1. Malting resulted in decrease of 1000 kernel weight by 0.45 to 19.0 g and the volume by 0.50 to 31.2 ml. A noticeable level of decrease in grain hardness was also observed in all grains after malting because the malts of the grains had shrunken appearance and their hardness was considerably lower (1.1 to 5.9 kg/cm<sup>2</sup>) than the native grains. Malting helped to reduce the bulk density of the malted mixes. Similar observations in weight, volume and hardness of native and malted grains were reported by Suhasini et al. (1995) and Sangita et al. (2000).

### Chemical composition of native grains, germinated grains and malted mixes

The chemical compositions of native grains, germinated grains and malted mixes are given in Table 2. It was observed that wheat malted mix has significantly higher ( $p < 0.00$ ) content of fat (2.27 g), carbohydrate (98.0 g) and calories (396 k.cal). Whereas, ragi malted mix has significantly higher ( $p < 0.05$ ) content of calcium (440 mg), thiamine (0.7 mg), riboflavin (0.9 mg) and amylase activity (169 mg%) when compared to native and germinated grains. Aisien (1982) and Glennie (1984) reported significant decrease in fibre on malting due to cell wall degradation during sprouting process. The results in the present study can be comparable with the results reported by Malleshi et al. (1981). However, germinated greengram had significantly higher ( $p < 0.05$ ) content of protein (33.0 g), fibre (11.5 g), iron (8.0 g) and vitamin C (157.8 mg). Thus, the incorporation of malted greengram mix and skimmed milk powder to the wheat malted mix and ragi malted mix helped to improve nutritional status of vulnerable segments of population with regard to protein, energy, iron, calcium and 'B' complex vitamins status.

### Impact of supplementary feeding on the nutritional status of preschool children

#### Anthropometric assessment

Measurements of height, weight and midupper arm

**Table 1.** Physical parameters of native and malted grains (ragi, wheat and greengram).

S/N	Parameter	Ragi	Wheat	Greengram
1	Colour	Creamish White	Brown	Green
2	Texture	Hard	Hard	Hard
	Length (cm)			
3	Native	0.65	-	0.55
	Malted	0.75	-	0.5
	Width (mm)			
4	Native	0.35	-	0.45
	Malted	0.34	-	0.4
	1000 – Kernel wt (g)			
5	a) Native	52.00	2.87	44.0
	b) Malted	47.90	2.42	25.0
	1000 – Kernel volume (ml)			
6	Native	35.50	2.80	64.5
	Malted	33.70	2.30	33.3
	Hardness (kg/cm <sup>2</sup> )			
7	Native	13.10	1.90	7.6
	Malted	7.20	0.80	3.5

**Table 2.** Nutrient composition of native, germinated grains and malted mixes (per 100 g).

S/N	Parameter	Native flour			Germinated grains			Malted mixes	
		Ragi	Wheat	Green gram	Ragi	Wheat	Green gram	Ragi malted mix	Wheat malted mix
1	Moisture (g)	11.9	11.5	9.4	17.0	43.5	90.10*	8.0	7.6
2	Protein (g)	7.8	12.25	23.75	10.3	14.0	33.0*	15.3	19.0
3	Fat (g)	1.5	1.2	1.6	1.3	2.0	2.1	1.8	2.27*
4	Fibre (g)	3.3	2.0	4.0	1.8	10.5	11.5*	2.0	8.0
5	Ash (g)	2.6	2.4	3.6	2.0	2.0	4.5*	2.9	1.8
6	Carbohydrates (g) <sup>b</sup>	72.6	71.0	57.0	75.0	82.1	60.8	94.51	98.0*
7	Energy (k.cal) <sup>c</sup>	336	348	228.0	390.0	403.0	380.0	376	396*
8	Calcium (mg)	350	30.0	320.0	242.0	54.0	109.0	440*	193.2
9	Iron (mg)	3.9	3.5	4.0	7.7	5.0	8.0*	4.4	5.9
10	Vitamin C (mg)	-	-	-	8.7	5.0	157.8*	25	14.1
11	Thiamine (mg)	0.19	0.17	0.28	-	0.9	0.37	0.7*	0.4
12	Riboflavine (mg)	0.42	0.45	0.43	-	1.23	0.31	0.9*	0.5
13	Amylase activity <sup>@</sup>	10.0	6.0	3.0	169*	145	132	117	102

<sup>@</sup>, mg maltose released by 1 g of malt flour when acted on 1 ml of 1% starch at 37°C for 30 min. \*, Significant at 5% level; <sup>b</sup>, calculated; <sup>c</sup> Computed.

circumference are commonly recognized as important indices of protein – energy malnutrition. The basic principle of anthropometry is that prolonged or severe

nutrient depletion eventually leads to retardation of linear (skeletal) growth in children and to loss of, or failure to accumulate, muscle mass and fat in both children and

**Table 3.** Mean height of preschool children.

Group	Supplementation period (3 months)			't' value
	Before	After	Increase in height (cm)	
Control I	83.33	83.64	0.49	9.74**
Group II	77.97	84.18	4.24	78.19**
Group III	79.82	83.64	3.81	85.19**
NCHS standards	109.9	-	-	-
'F' value	-	0.153 <sup>NS</sup>	-	-
Level of significance between experimental groups	-	0.153 <sup>NS</sup>	0.43	-

n = 400; NS, not significant; \*\*, Significant at 1% level.

**Table 4.** Mean weight of preschool children.

Group	Supplementation period (3 months)			't' value
	Before	After	Increase in weight (kg)	
Control I	11.54	12.14	0.6	16.63**
Group II	10.61	12.35	1.72	193.63**
Group III	10.74	12.49	1.74	85.19**
NCHS standards	18.7	-	-	-
'F' value	-	148.98**	-	-
Level of significant between experimental groups	-	0.21 <sup>NS</sup>	0.02	-

n = 400; NS, not significant; \*\*, significant at 1% level.

adults. These problems can be detected by measuring body dimensions, such as standing height or upper-arm circumference or total body mass, that is, weight (Hoddinott, 2002). The mean increase in height of the preschool children was significant ( $p < 0.01$ ) in both experimental and control groups after supplementation (Table 3). When compared to control, significant difference ( $P < 0.01$ ) in height was not observed in both experimental groups after supplementation.

Sankhala et al. (2004) also observed an improvement in the height of malnourished children (6 to 10 years) after feeding paushtic laddu and mathari for a period of 90 days. The increment in height was of greater magnitude as compared to their control counterparts yet the difference was statistically non significant. Significant increase in height of preschool children in control group after 3 months period could be due to consumption of RTE food provided by the ICDS supplementary programme. Similar findings were observed by Bhagyalakshmi and Vijayalakshmi (2002), whereby effect of supplementation in ICDS beneficiaries (3 to 4 years old girls) was studied. A reduction in height deficit from 25 to 11% of National Centre for Health Statistics (NCHS) values after one year of feeding was found.

In the present study, increase in height was greater than the figures reported by Gopalan et al. (1996), that is, an increase of 2.3 cm in height was observed in the

preschool children for a period of four months supplementation. It was mainly due to providing additional calories and protein through malted mixes, which promoted better growth.

The increase in height observed in the present study in three months period is comparable to the values reported by Devadas et al. (1984), even though the quantity of protein and calorie provided by Devadas et al. (1984) was more as compared to the present study. The better impact was perhaps due to the more calorie gap in the present study.

Table 4 shows that the mean gain in weight by the preschool children increased significantly ( $P < 0.01$ ) in both experimental and control groups after supplementation. A significant improvement in weight of the preschool children was observed in both the experimental groups after supplementation as compared to control due to consumption of amylase rich malted mixes which helped in decrease the bulk density and improving the digestibility and nutritional quality. Hossain et al. (2005) also observed higher weight gain and increments in length and weight-for-height in 65 malnourished children after receiving amylase rich flour added supplementary food for a period of 6 weeks.

The gain in weight by the preschool children in the present study was three times more than the gain in weight (0.56 kg) reported by Gopalan et al. (1996) for a

**Table 5.** Frequency distribution of Preschool Children as per Gomez classification\*.

S/N	Gomez classification	Control I		Group II		Group III	
		Before	After	Before	After	Before	After
1	90% and above (Normal)	-	2 (10)	- (0)	38 (19)	- (0)	76 (38)
2	75-90% Grade I (Mild)	7 (35)	8 (40)	85 (43)	108 (54)	117 (59)	72 (36)
3	60-75% Grade II (Moderate)	7 (35)	5 (25)	65 (32)	49 (25)	33 (16)	52 (26)
4	<60% Grade III (Severe)	6 (30)	5 (25)	50 (25)	5 (2)	50 (25)	- (0)

n = 400, \* Gomez classification (weight/age)

**Table 6.** Mean mid upper arm circumference of preschool children.

Group	Supplementation period (3 months)			
	Before	After	Increase in MUAC (cm)	't' value
Control I	12.92	13.23	0.31	18.44**
Group II	12.83	13.33	0.5	78.19**
Group III	12.70	13.3	0.68	142.25**
ICMR standard*	14.7	-	-	-
'F' value	-	0.512 <sup>NS</sup>	-	-
Level of significance between experimental groups	-	0.04 <sup>NS</sup>	0.18	-

n = 400, NS- Not Significant; \*\* - Significant at 1% level; \*-Gopalan et al. (1996)

**Table 7.** Mean hemoglobin level of preschool children

Group	Before	After	Increase in hemoglobin level (g/dl)	't' Value
Control I	9.32	9.46	0.14	11.77**
Group II	9.41	9.69	0.28 <sup>NS</sup>	35.41**
Group III	9.32	9.59	0.27 <sup>NS</sup>	79.91**
ICMR standard*	11 - 12	-	-	-
'F' value	-	0.431 <sup>NS</sup>	-	-
Level of significance between experimental groups	-	0.02 <sup>NS</sup>	0.1	-

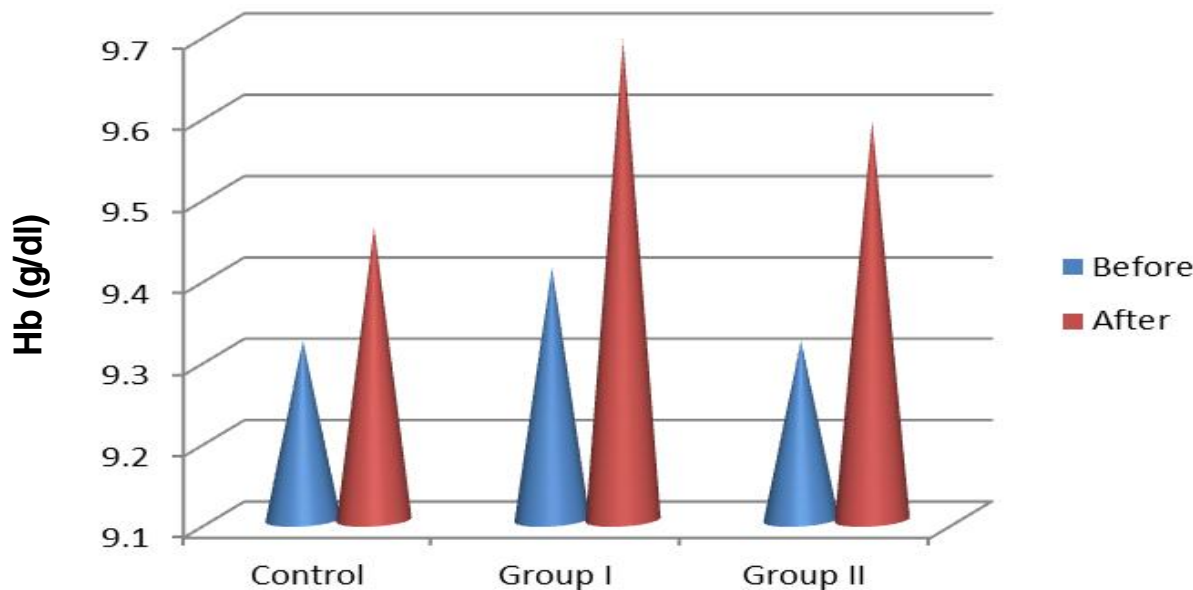
n = 400; NS, not significant ; \*\*, Significant at 1% level; \*, Gopalan et al. (1996).

period of four months supplementation. The additional calories and protein supplied through malted mixes must have increased the weight at a much rapid rate than normal weight.

The children in the present study showed greater gain in weight than the observations made by Upadhy (1970), that is, 15.4 kg who supplemented with wheat flour, bengal gram flour, peanut, skim milk powder, which provided 260 k cal and 10 g of protein for 6 weeks.

As per Gomez classification in experimental Group II, 2% of the preschool children were severely malnourished. Whereas none of the preschool children in the experimental Group III were severely malnourished after supplementation (Table 5).

On completion of three months duration feeding trials, the significant improvement ( $p < 0.01$ ) in the mean mid upper arm circumference (MUAC) of both the experimental and control groups of preschool children was found (Table 6). However, when compared to control the increase was not found to be statistically significant in both the experimental groups. Supplementation of RTE food through ICDS supplementary programme could be a reason of significant increase in MUAC of preschool children in control group after 3 months period. Effect of *misola* (Porridge) consisted of millet, soybean, peanut, vitamins, minerals, and industrial amylase was studied on 300 malnourished children aged 6 to 48 months. After eight weeks of nutritional rehabilitation an improvement in



**Figure 1.** Mean hemoglobin level (g/dl) of preschool children (n = 400).

weight, height, head perimeter (HP) and MUAC was found (Zoenabo et al., 2012)

#### **Biochemical estimation**

Table 7 presents that, the mean increase in hemoglobin level of the preschool children was significant ( $p < 0.01$ ) in both experimental and control groups after supplementation. Though, it was not statistically increased in both the experimental groups when compared to control. Significant increase in hemoglobin level of preschool children in control group after 3 months period could be due to consumption of RTE food supplied by the ICDS (Figure 1). The mean hemoglobin level of preschool children in both the experimental and control groups was lower than the WHO cut off values, that is, 11 to 12 g/dl for preschool children. This clearly indicated that the supplementation of malted mixes for at least 6 months with fortified vitamins and minerals would have better improvement.

#### **Impact of supplementary feeding on the nutritional status of pregnant women**

##### **Anthropometric assessment**

In both the experimental and control groups, significant difference in height of the pregnant women was not observed after supplementation. No significant gain in weight of the pregnant women was observed in both the experimental and control groups after supplementation (Table 8). The maximum increase in

weight was observed in Group III (5.32 kg), that is, pregnant women fed with wheat malted mix followed by Group II (5.29 kg), that is, pregnant women fed with ragi malted mix. An increase in weight (3.50 kg) was observed in the control group women. The results observed in the present study can be comparable to the values reported by Kumari and Singh (2004).

#### **Biochemical estimation**

The mean increase in hemoglobin level by the pregnant women increased significantly in both experimental and control groups after supplementation (Table 8, Figure 2). When compared to control, significant increase ( $P < 0.01$ ) in hemoglobin level of pregnant women was observed in the experimental groups. Chaudhary (2004) also found an increase in Hb (1 to 2 g%) and weight gain (3 to 5 kg) of pregnant women of age 20 to 35 years, at 16 to 36 weeks of gestation, after supplementing a laddoo made with soya flour, wheat flour, roasted gram flour, groundnut, ghee and jaggery for a period of 12 weeks. An increase in Hb level (1.4 g/dl) of pregnant women was also reported by Kumari and Singh (2004) after supplementing quality protein from maize, green gram, ragi, gingerly seeds, amaranthus and jaggery.

#### **Impact of supplementary feeding on the nutritional status of lactating women**

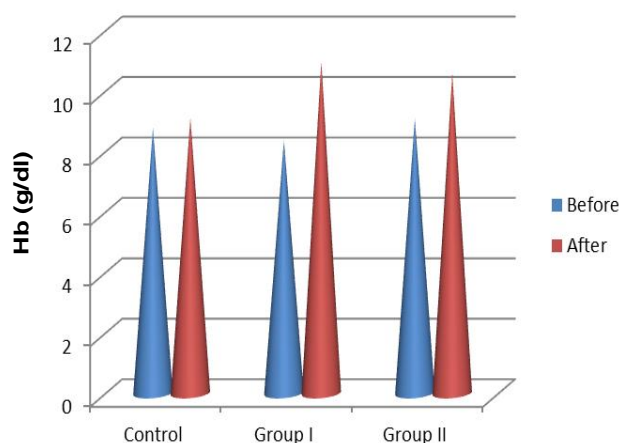
##### **Anthropometric assessment**

The difference in height before and after the study of both

**Table 8.** Mean height, weight and hemoglobin level of pregnant women.

Group	Height (cm)				Weight (kg)				Hemoglobin level (g)			
	Before	After	Increase	't' Value	Before	After	Increase	't' Value	Before	After	Increase	't' Value
Control I	151.19	151.55	0.36	19.56**	43.14	46.64	3.50	15.98**	9.35	9.62	0.27	18.59**
Group II	151.19	151.69	0.50	8.28**	42.56	47.85	5.29	35.64**	9.35	11.00	1.67	40.01**
Group III	151.51	151.89	0.38	31.68**	43.16	48.48	5.32	45.28**	9.46	10.82	1.36	38.60**
Standard 'F'Value	-	0.74 <sup>NS</sup>			-	1.24 <sup>NS</sup>			12 - 14 g	14.25**		
Level of significance between experimental groups		0.02 <sup>NS</sup>	0.28		0.16 <sup>NS</sup>	0.03			0.12 <sup>NS</sup>	0.31		

n = 100, NS, Not Significant; \*\*, Significant at 1% level.



**Figure 2.** Mean hemoglobin level (g/dl) of pregnant women (n = 100).

the experimental and control groups was found to be statistically non significant (Table 9). The mean gain in weight of the lactating women increased significantly in both experimental and control groups after supplementation. However, when compared to control significant increase ( $P < 0.01$ )

in weight was observed in both experimental groups. The mean increase in hemoglobin level (Table 9, Figure 3) was significant in both experimental and control groups after supplementation. A significant difference ( $P < 0.01$ ) in hemoglobin level was observed in both the experimental groups when compared to their control counterparts. Devadas et al. (1982) reported that the supplementation of indigenous low cost nutritive foods has a definite effect on the nutritional status of the nursing mothers.

**BMI classification**

The BMI classification for frequency distribution of pregnant (Table 10) and lactating women (Table 11) showed that 4% of both the pregnant and lactating women were severely malnourished in experimental Group II, where as none of them were severely malnourished in experimental Group III. Studies carried out at National Institute of Nutrition revealed that 75% of pregnant women in India are anaemic and anaemia remains to be a major factor responsible for maternal morbidity,

mortality and low birth weight. Continuous supplementation to those with energy gap helps to reduce under nutrition in pregnant and lactating women (<http://wcd.nic.in/research/nti1947>).

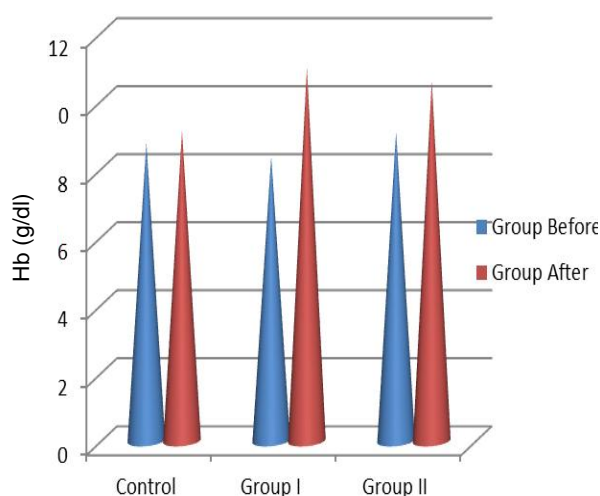
**Prevalence of nutritional deficiency symptoms in preschool children**

Assessment of the nutritional status was done based on the nutritional deficiency symptoms viz. protein energy malnutrition (PEM), vitamin A, vitamin C, vitamin D, B complex vitamin deficiency, iron deficiency and iodine deficiency symptoms in preschool children (Table 12). The results indicated that 60% of the preschool children in the control group were suffering from PEM before supplementation, whereas in both the experimental groups, that is, in Groups II and III, 16 and 17.5% of preschool children had PEM symptoms. There was a considerable reduction in the PEM deficiency symptoms of the experimental Group II (11%) and Group III (7%) than that of control group (2%). The reduction of protein energy malnutrition in the experimental groups

**Table 9.** Mean height, weight and hemoglobin level of lactating women.

Group	Height (cm)				Weight (kg)				Hemoglobin level (g)			
	Before	After	Increase	't' value	Before	After	Increase	't' value	Before	After	Increase	't' value
Control I	149.56	149.56	-	0.00 <sup>NS</sup>	40.50	41.78	1.25	6.08**	8.77	9.11	0.34	17.33**
Group II	150.76	150.95	0.19	20.97**	41.05	43.78	2.73	46.43**	8.37	10.98	2.61	46.38**
Group III	149.95	150.04	0.09	18.69**	40.65	43.35	2.70	46.24**	9.09	10.58	1.49	45.64**
Standard 'F'Value		1.365 <sup>NS</sup>				12.07**				77.86**		
Level of significance between experimental groups		0.03 <sup>NS</sup>	0.1		0.00 <sup>NS</sup>	0.03			0.1 <sup>NS</sup>	1.12		

n = 100, NS- Not Significant; \*\* - Significant at 1% level.



**Figure 3.** Mean hemoglobin level (g/dl) of lactating women (n = 100).

was mainly due to additional intake of calories and protein through the supplementary food.

Similarly, 50% reduction in vitamin A deficiency symptoms was observed in the preschool children of both the experimental and control groups after

supplementation. This was mainly because of taking vitamin 'A' drops through primary health care centers.

None of the preschool children had vitamin 'D' and iodine deficiency symptoms during the experimental period. There was 50% improvement in the 'B' complex vitamin deficiency and vitamin C deficiency symptoms in preschool children of experimental groups. No change was observed in deficiency symptoms over 'B' complex vitamin and vitamin C in the control group by the end of the study period. This is mainly because malted grains are good sources of vitamin C and B complex vitamins.

Anemia is one of the common nutritional deficiencies seen in a large percentage of low-income population.

Lack of iron in the body leads to anemia. Considerable improvement (50%) in the iron nutritional status of preschool children of experimental groups was observed after supplementation. Iron deficiency symptoms increased in case of control group. Apart from iron deficiency in their diets, poor hygienic conditions and unsanitary surroundings may also be responsible for high incidence of anemia.

### Prevalence of nutritional deficiency symptoms of pregnant and lactating women

Clinical examination of pregnant and lactating women was carried out before and after supplementation with the help of medical practitioner (Tables 13 and 14).

Deficiency symptoms viz. PEM, vitamin A, vitamin C, vitamin D, B complex vitamins, iron and iodine in pregnant and lactating women of experimental as well as control groups were observed. 50% reduction in the deficiency symptoms of PEM by pregnant and lactating women in the experimental groups was observed; whereas, considerable reduction in deficiency symptoms of PEM was not observed in case of control group women. This was mainly because of supplementation of additional calories and protein through malted mixes.

Similarly, 'B' complex vitamin deficiency and vitamin C deficiency symptoms were lower (50%) in both the pregnant and lactating women of experimental groups. None of the pregnant and lactating women had vitamin A, vitamin D and iodine deficiency symptoms during the study period. Considerable reduction in the iron



**Table 10.** Frequency distribution of pregnant women as per BMI\*classification.

BMI grade	Groups					
	Control I		Group II		Group III	
	Before	After	Before	After	Before	After
Grade III, Severe (<16.0)	2 (9)	1 (8)	10 (20)	2 (4)	10 (20)	(0)
Grade II, Moderate (16.0 - 17.0)	6 (30)	4 (18)	11 (22)	6 (12)	7 (14)	2 (4)
Grade I, Mild (17.0 - 18.5)	12 (61)	3 (13)	29 (58)	10 (20)	33 (66)	12(24)
Normal (18.5-25.0)	(0)	12 (61)	(0)	32 (64)	(0)	36 (72)

n=100; BMI\*, body mass index = wt (kg)/Ht<sup>2</sup> (mt).

**Table 11.** Frequency distribution of lactating women as per BMI\* classification.

BMI grade	Groups					
	Control I		Group II		Group III	
	Before	After	Before	After	Before	After
Grade III, Severe (<16.0)	4 (22)	4 (22)	10 (20)	2 (4)	10 (20)	(0)
Grade II, Moderate (16.0 - 17.0)	7 (34)	8 (35)	25 (50)	17 (34)	24 (48)	16 (32)
Grade I, Mild (17.0 - 18.5)	9 (44)	6 (30)	15 (30)	16 (32)	16 (32)	21 (42)
Normal (18.5 - 25.0)	(0)	2 (13)	(0)	15 (30)	(0)	13 (26)

n = 100, BMI\* - Body Mass Index = wt [kg/Ht<sup>2</sup> (mt)].

**Table 12.** Frequency distribution of preschool children in view of nutritional deficiency symptoms.

Symptoms of nutritional deficiency	Control I		Group II		Group III	
	Before	After	Before	After	Before	After
Protein energy malnutrition	12 (60)	10 (50)	32 (16)	10 (5)	35 (17.5)	21 (10.5)
Vitamin A deficiency	8 (10)	2 (10)	12 (6)	7 (3.5)	5 (2.5)	3 (1.5)
Vitamin D deficiency	-	-	-	-	-	-
B Complex vitamin deficiency	5 (25)	6 (30)	26 (13)	11 (5.5)	20 (10)	9 (4.5)
Vitamin C deficiency	3 (15)	3 (15)	29 (14.5)	19 (9.5)	32 (16)	12 (6)
Iron deficiency	9 (45)	9 (45)	48 (24)	23 (11.5)	52 (26)	25 (12.5)
Iodine deficiency	-	-	-	-	-	-

n = 400. Note: Figures in the parenthesis indicates percentages.

**Table 13.** Frequency distribution of pregnant women in view of nutritional deficiency symptoms.

Symptoms of nutritional deficiency	Control I		Group II		Group III	
	Before	After	Before	After	Before	After
Protein energy malnutrition	9.0 (45)	8.0 (40)	24.0 (48)	10.0 (20)	21.0 (42)	11.0 (22)
Vitamin A deficiency	-	-	-	-	-	-
Vitamin D deficiency	-	-	-	-	-	-
B Complex vitamin deficiency	7.0 (35)	8.0 (40)	19.0 (38)	9.0 (18)	21.0 (42)	11.0 (22)
Vitamin C deficiency	9.0 (45)	8.0 (40)	15.0 (30)	5.0 (10)	17.0 (34)	7.0 (14)
Iron deficiency	14.0 (70)	19.0 (95)	32.0 (64)	17.0 (34)	39.0 (7.8)	20.0 (40)
Iodine deficiency	-	-	-	-	-	-

n = 100; Figures in the parenthesis indicates percentages.

deficiency symptoms was also observed in the pregnant women (40%) and lactating women (50%) of

experimental groups. Not much improvement in the iron nutritional status was observed in case of pregnant

**Table 14.** Frequency distribution of lactating women in view of nutritional deficiency symptoms.

Symptoms of nutritional deficiency	Control II		Group II		Group III	
	Before	After	Before	Before	After	Before
Protein energy malnutrition	13.0 (65)	12.0 (60)	28.0 (56)	13.0 (26)	25.0 (50)	12.0 (24)
Vitamin A deficiency	-	-	-	-	-	-
Vitamin D deficiency	-	-	-	-	-	-
B Complex vitamin deficiency	8.0 (55)	8.0 (40)	19.0 (38)	8.0 (16)	15.0 (30)	6.0 (12)
Vitamin C deficiency	11.0 (55)	8.0 (40)	12.0 (24)	6.0 (12)	16.0 (32)	6.0 (12)
Iron deficiency	12.0 (60)	15.0 (75)	39.0 (78)	21.0 (42)	35.0 (70)	18.0 (36)
Iodine deficiency	-	-	-	-	-	-

n = 100; Figures in the parenthesis indicates percentages.

**Table 15.** Frequency distribution of Preschool children as per Morbidity pattern.

S/N	Type of illness	Control I		Group II		Group III	
		Before	After	Before	After	Before	After
1	Diarrhea	4 (20)	5 (25)	23 (11.5)	15 (7.5)	22 (11)	14 (7)
2	URI	5 (25)	3 (15)	7 (8.5)	6 (3)	15 (7.5)	4 (2)
3	Bronchitis	-	-	-	-	-	-
4	Vomiting	8 (40)	7 (35)	26 (30)	18 (9)	24 (12)	16 (8)
5	Fever	4 (20)	3 (15)	13 (6.5)	6 (6.5)	11 (5.5)	4 (2)
6	Malaria	-	-	-	-	-	-
7	Measles	2 (10)	1 (5)	4 (2)	2 (1)	4 (2)	1 (0.5)
8	Skin infection	6 (30)	4 (20)	10 (5)	7 (3.5)	13 (6.5)	12 (6)
9	Dysentery	-	-	-	-	-	-
10	Ear infection	3 (15)	3 (15)	17 (8.5)	10 (5)	15 (7.5)	7 (3.5)
11	Eye infection	2 (10)	1 (5)	16 (8)	7 (3.5)	11 (5.5)	5 (2.5)
12	Scabies	-	-	-	-	-	-
13	Cough	7 (35)	7 (35)	18 (9)	8 (4)	13 (6.5)	6 (3)
14	Whooping cough	-	-	-	-	-	-
15	Chicken pox	-	-	-	-	-	-
16	Jaundice	2 (10)	3 (15)	11 (5.5)	2 (1)	9 (4.5)	3 (1.5)
17	Sour mouth	5 (25)	4 (20)	11 (5.5)	4 (2)	9 (4.5)	2 (1)
18	Edema	11 (55)	13 (65)	82 (41)	62 (31)	80 (40)	60(30)

n = 400; Figures in the parenthesis indicates percentages.

and lactating women in control group.

### Morbidity pattern of preschool children, pregnant women and lactating women

A varied spectrum of illness were seen viz. diarrhea, upper respiratory infection (URI), vomiting, fever, meseals, skin infection, ear and eye infection, cough, jaundice, sour mouth and edema in the sample studied before and after supplementation in three groups of preschool children, pregnant women and lactating women of both the control and two experimental groups. Considerable decrease in the incidence of various

morbidities was observed in preschool children, pregnant women and lactating women of both the experimental groups compared to control group after supplementation (Tables 15 to 17). Most of the important infections in the preschool children, pregnant women and lactating women render their consequences more seriously by the presence of malnutrition.

### Conclusion

Supplementation of ARMMs incorporated food products to the vulnerable groups of population in Lepakshi mandal of Ananthapur district, Andhra Pradesh, India

**Table 16.** Frequency distribution of pregnant women as per morbidity pattern.

S/N	Type of illness	Control I		Group II		Group III	
		Before	After	Before	Before	After	Before
1	Diarrhea	4 (20)	4 (20)	11 (22)	5 (10)	19 (38)	12(24)
2	URI	3 (15)	3 (15)	5 (10)	2 (4)	6 (12)	2 (4)
3	Bronchitis	-	-	-	-	-	-
4	Vomiting	15 (75)	13 (65)	26 (52)	12 (24)	28 (56)	14 (28)
5	Fever	6 (30)	4 (20)	14 (28)	8 (16)	12 (24)	6 (12)
6	Malaria	-	-	-	-	-	-
7	Measles	-	-	-	-	-	-
8	Skin infection	6 (30)	5 (25)	5 (10)	2 (4)	6 (12)	3 (6)
9	Dysentery	-	-	-	-	-	-
10	Ear infection	3 (15)	2 (10)	4 (8)	2 (4)	3 (6)	1 (2)
11	Eye infection	2 (10)	2 (10)	1 (2)	1 (2)	1 (2)	-
12	Scabies	-	-	-	-	-	-
13	Cough	8 (40)	6 (30)	7 (14)	3 (6)	4 (8)	2 (4)
14	Whooping cough	-	-	-	-	-	-
15	Chicken pox	-	-	-	-	-	-
16	Jaundice	3 (15)	2 (10)	6 (12)	3 (6)	6 (12)	3 (6)
17	Sour mouth	5 (25)	7 (35)	15 (30)	3 (6)	13 (26)	5 (10)
18	Edema	9 (45)	9 (45)	33 (66)	18 (36)	39 (78)	11 (22)

n = 100; Figures in the parenthesis indicates percentages.

**Table 17.** Frequency distribution of lactating women as per morbidity pattern.

S/N	Type of illness	Control I		Group II		Group III	
		Before	After	Before	Before	After	Before
1	Diarrhea	9 (45)	8 (40)	10 (20)	5 (10)	9 (18)	5 (10)
2	URI	7 (35)	2 (10)	7 (14)	-	8 (16)	2 (4)
3	Bronchitis	-	-	-	-	-	-
4	Vomiting	9 (45)	6 (30)	10 (20)	4 (8)	9 (18)	5 (10)
5	Fever	6 (30)	4 (20)	13 (26)	8 (16)	11 (22)	6 (12)
6	Malaria	-	-	-	-	-	-
7	Measles	-	-	-	-	-	-
8	Skin infection	2 (10)	2 (10)	4 (8)	2 (4)	5 (10)	4 (8)
9	Dysentery	-	-	-	-	-	-
10	Ear infection	1 (5)	1 (5)	2 (4)	1 (2)	2 (4)	1 (2)
11	Eye infection	1 (5)	1 (5)	-	-	1 (2)	1 (2)
12	Scabies	-	-	-	-	-	-
13	Cough	5 (25)	1 (5)	2 (4)	1 (2)	2 (4)	1 (2)
14	Whooping cough	-	-	-	-	-	-
15	Chicken pox	-	-	-	-	-	-
16	Jaundice	-	-	-	-	-	-
17	Sour mouth	3 (15)	2 (10)	4 (8)	3 (6)	4 (8)	3 (6)
18	Edema	8(40)	8 (40)	26 (52)	14 (28)	39 (78)	15 (30)

n = 100, Note: Figures in the parenthesis indicates percentages.

showed that significant increase ( $P < 0.01$ ) was observed in weight and height of preschool children, weight of lactating women and hemoglobin level of pregnant and

lactating women after supplementation. The results of clinical assessment showed considerable reduction (50%) in nutritional deficiency symptoms and morbidity

rate of preschool children, pregnant women and lactating women in experimental groups compared to control group at the end of the study.

Hence, these nutrient dense, easily digestible food products prepared with malted mixes will be beneficial to children, teenagers, anemic patients, pregnant women and lactating women. Further, these feeding trials could be carried out for geriatric population also.

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