Formulation and Nutritional Appraisal of Low Cost Enteral Formula

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Abstract- Enteral feeding formula has shown to be beneficial in cancer patients, where otherwise the gut is efficacious in digestion and absorption of food but oral intake is not possible due to anorexia, tumor burden, and side effects of treatments. Long term enteral feeding programmed with extreme use of commercially available expensive enteral formula all pose a requirement of development of an Low Cost Enteral Formula (LCEF). Aim: to formulate low cost enteral formula and analyze its nutritional composition in comparison to other commercial formulae available in market. Material and Methods used: the low cost enteral formula using indigenous grains was developed by undergoing to different procedures. The formula obtained was then standardized along with commonly used commercial nutraceutical products. Both these were evaluated for nutritional value and cost. A study was conducted wherein LCEF was supplemented to post surgery head and neck cases in comparison to control group who were fed a commercially available nutraceutical supplement. A pre and post intervention comparative study was conducted including various parameters- weight, MUAC, BMI, Serum Protein, Serum Albumin and hemoglobin. Results: the low cost enteral formula developed, provided similar macro and micronutrients with low cost as compared to commercially available formulas. The results as indicated by various parameters showed that the experimental and control group had similar results. Patients also had good tolerance for the feed. Conclusion: LCEF can be used as an enteral formula in exchange to other commercial nutraceutical supplements available because of its cost effectiveness, similar nutritional content, easy to prepare at home, with nutrients in natural food form, making adaptation to normal foods easy and thus providing emotional comfort to patients.

Index Terms- Cancer, Enteral formula, Low cost, Nutrition.

I. Introduction

Cancer has become one of the leading causes of death in India. Caring for patients with cancer has become increasingly complex as there is no single case for the disease (Jain, 2003). Doctors and dieticians should be constantly aware of the diagnostic significance of loss of weight, anorexia, food aversions as early signs of malignant disease; when the diagnosis has been made and program of ablative surgery, radiation or treatment with cytotoxic drugs are laid down, a supportive diet should be carefully drawn up (Bloch AS, 1990). While the patient is being treated in the hospital, use of commercial formula makes it easier for the provision of energy, protein and all essential micronutrients. As many patients are from low socio-economic group, it may not be possible for all the patients to use ready to use, disease specific, and expensive nutrition products especially after obtaining discharge from the hospital. Thus it was important to formulate complete nutrition for cancer patients at home level developing appropriate low cost enteral feed formula as compared to commercially available expensive formulae in market.

II. Review of Literature

The word 'Cancer' is derived from Latin word meaning Crab. Later, the term neoplasm was coined by scientist named Galen. He defined cancer as new growths contrary to nature. The ability of the neoplasm to migrate to other tissue or organ and form additional tumor is called metastasis. There are two categories of tumor; benign, which are slow in growth, encapsulation, and noninvasiveness and there is microscopic similarity to surrounding tissue. Whereas malignant tumors exhibit rapid growth, are invasive in nature and are large and abnormal in shape.

Table 1: Types of Cancer

Four most common cancers	Breast, Colon, Lung, Prostrate, Head and Neck, esophageal
Hematolymphoid Cancer	Hodgkin's Disease, Leukemia, Multiple Myeloma
Skin Cancer	Malignant Melanoma
Gastrointestinal Cancer	Head and Neck, Esophageal, Stomach, Pancreas, Liver, Colon, Rectal, Anal
Urinary Cancer	Kidney, Bladder, Testis, Prostrate
Cancers in Women	Breast, Ovarian, Gynecological, Choriocarcinoma
Miscellaneous Cancers	Brain tumor, Bone tumor, Carcinoid tumor, Nasopharyngeal cancer, Retropertoneal sarcomas, soft tissue tumors, thyroid cancer, cancers of unknown primary site

Head and Neck Cancer:

5-10% of all the cancers involve head and neck site. The term head and neck cancer refers to all those which affects the human body above the collarbone, excluding the brain and central nervous system.

Table 2: Types of Head and Neck Cancers

Types of Head and Neck Cancers:	Cancer of Lip
	Cancer of Tongue
	Cancer of Floor of the Mouth
	Cancer of Buccal Mucosa
	Cancer of Gingival (Gums)
	Cancer of Oropharynx
	Cancer of Hypopharynx
	Cancer of Larynx
	Cancer of Nasopharynx

Diagnosis:

Cancer at early stages has no symptoms. As the oral cancer progresses, the patient can often feel a lump in the mouth, ulceration in the lip or tongue, sore spot. In case of advanced cancer pain, bleeding, loss of teeth or change in speech may develop. Diagnosis includes: physical examination, routine laboratory tests, X-ray, CT scan, and Biopsy. Staging of cancer is the process of finding out how far the cancer has spread. The prognosis largely depends upon the cancer stage. Staging information is obtained from physical examination, endoscopies, and imaging studies (CT scan, MRI, X-Ray, Nuclear Medicine scans). The most common system used to describe the extent of oral cavity and oropharyngeal cancer is TNM system of American Joint Committee on Cancer (AJCC). TNM stands for Tumor, Nodes and Metastases respectively.

Treatment:

Treatment option includes surgery, radiation a combination of both and occasionally chemotherapy. The aim is to eradicate the cancer with the best cosmetic result.

Surgery- surgery involves removal of the tumor and a portion of healthy tissue. Since these tumors spread to cervical lymph nodes in the neck, a radical neck dissection is frequently performed. Surgical resection of the head and neck areas has the potential to severely restrict or eliminate oral intake. Complications post-operatively such as infection, development of fistulae, sepsis, will increase nutritional requirements (Northern Cancer Network, Head and Neck Cancer Nutritional Guidelines)

Radiation- radiation is used both alone and in combination with surgery for treatment. Radiation therapy uses ionizing radiation to kill cancer cells and shrink tumors. It damages both cancer cells and normal cells, though normal cells can recover from the effect of radiation and function properly.

Table 3: Effects of Radiation

Acute effects of Radiation Therapy on Head and Neck Cancers	Late effects of Radiation Therapy on Head and Neck Cancers (> after 90 days of treatment)
Xerostomia, sore mouth and throat, dysphagia, odynophagia, mucositis, alterations in taste and smell, fatigue, loss of apettite.	Mucosal atrophy and dryness, ulceration, salivary gland xerostomia, fibrosis, osteoradionecrosis, alterations in taste and smell.

Chemotherapy- chemotherapy uses anticancer drugs that are given intravenously or orally. Chemotherapy is sometimes given to shrink the tumor before surgery or radiation therapy, which is called neoadjuvant chemotherapy.

Nutritional effects of cancer:

Cancer Cachexia- the term describes a group of symptoms and signs that encompasses initiation, anorexia, anemia, weakness, tissue wasting and organ dysfunction.

Table 4: Metabolic effects during cancer

Metabolic Components	Parameters	Effects
Energy	Energy expenditure Energy Balance Energy Store	Increases Negative Decreases
Carbohydrate	Body Glucose Composition	Increases
Lipid	Lipoprotein lipase activity Fat synthesis Fat breakdown Serum triglyceride levels Serum lipid levels	Decreases Decreases Increases Increases Increases
Protein	Body muscle mass Skeletal protein synthesis Skeletal protein breakdown Liver protein synthesis Whole body protein synthesis Nitrogen balance Plasma Branched chain amino acid	Decreases Decreases Increases Increases Increases Increases Decreases
Water	Total body water	Increases

(Soube WW *et al*, 1985)

Nutrition care of the patients with Cancer:

A common secondary diagnosis in patients with advanced neoplastic disease is protein energy malnutrition. Weight loss and altered nutritional status are evident in 50% of cancer patients at the time of diagnosis (Langstein and Norton, 1991).

Even small amount of weight loss pror to therapy (less than 5% of body weight) may worsen prognosis significantly (De Wys *et al*, 1980).

Goals of nutrition care:

1. Prevent or correct nutritional deficiencies
2. Minimize weight loss

Early intervention is essential and screening for risk of nutritional problems should occur at diagnosis and continue throughout treatment. Nutrition assessment and intervention must be timely and anticipate nutritional needs.

Enteral feeding:

By definition enteral means "within the or by the way of gastrointestinal tract"(Srilakshmi, 2002). Efforts to encourage oral intake sometimes fail or are inappropriate, and more aggressive feeding methods are requires. If the gut is functional, enteral tube feeding is utilized. Nasogastric or nasoenteric tubes are used for short term support. The selection of enteral formulas is determined by several factors, including the functional capacity of the gut, the intubations site, the patient's metabolic status, and considerations of cost and convenience especially in home use.

Table 5: Indications for Enteral Feeding

Physiological Problem	Clinical Problem
Inability to ingest food	Carcinoma of esophagus or stomach, dental or oral surgery, inflammatory disease of esophagus, coma
Inability to digest food	Pancreatitis, biliary tract disease
Decreased ability to handle colonic residue	Radiation therapy, sprue, inflammatory bowel disease
Inability to handle colonic residue	Inflammatory bowel disease, presurgical preparation, ileostomy, colostomy, draining fistula
Inability to meet nutritional requirement fully with normal food	Major surgery, burns, trauma, extended fever, anorexia of chronic illness, anorexia nervosa

Factors to consider when choosing a feeding formula:

Feeding formulas should be evaluated using following characteristics

1. Osmolarity
2. Viscosity
3. Appropriate macronutrient ratio to meet assessed needs
4. Suitability for contribution of fluid and electrolyte
5. Cost effectiveness (Krause and Mahan, 1996)

Contraindications of Enteral Feeding (American Society of Parenteral and Enteral Nutrition- ASPEN)- diffused peritonitis, intestinal obstruction that prohibits use of bowel, intractable vomiting, paralytic ileus, severe diarrhea, severe pancreatitis, enterocutaneous fistulae, gastrointestinal ischemia.

Feeding formulas

Enteral formulas can be categorized in three major groups:

1. Standard formulas- which is the largest group and includes concentrated formulas, high protein formulas, calorie dense formulas.
2. Pre-digested formulas- for patients with some degree of gastrointestinal dysfunction and are more easily absorbed than intact nutrients.
3. Disease specific formulas- in which nutrient profiles have been altered for specific disease state or immune enhancement.

Feeding methods

After it has been decided that which tube feed the patient will be receiving, the method of feeding has to be selected.

There are three types:

1. Continuous feeding- either by gravity or by using feeding pump, patient is feed 24 hours, drip by drip.
2. Intermittent feeding- feeding is given per bottle e.g.500ml, over a period of about an hour or a particular number of times a day.
3. Bolus feeding- is delivery of feeding multiple portions of 200-250ml.

III. METHODOLOGY

Low Cost Enteral Formula (LCEF) is a high calorie high protein enteral formula, designed originally by the dietician in a tertiary care cancer center in exchange to other commercial supplements available in the market.

Why is there a need for Low Cost Enteral Formula?

- The commercially available enteral formulae are usually polymeric or elemental defined formula diets.
- They have high osmolarity and can lead to partial gastric and ileac discomfort because none or very little digestion is required.
- Moreover, since nutrients are mostly in pure form, later adaptation of normal food intake takes time.
- Also they are expensive and not affordable by many patients.
- It has been observed that enteral food akin to normal diet but of improved digestibility and texture perform better nutritional support to patients with than elemental diet.
- The uses of familiar food bring about emotional comfort to the patient.
- Higher amount of dietary fiber, which helps to relive constipation unlike commercial formula.
- Commercial formula also provide with a fixed profile of nutrients which is not modifiable, whereas formulated feeds can be modified. Formulated feeds can be modified by addition or removal of certain ingredients.

The methodology followed 5 phases, as follows:

PHASE 1:

Table 6: Development of Low Cost Enteral Formula

Ingredients	Quantity
Whole Wheat	300g
Rice milled	100g
Ragi	100g
Green gram whole	300g
Soya beans	100g
Til	100g
Flax seed	100g
Sugar	200g
Skim milk powder	100g
Total	1400g

Nutritional importance of ingredients:

- Whole Wheat: good source of energy as 80 % of dry matter comprises of carbohydrates. It's a good source of various vitamins and minerals.
- Rice: it's a good source of carbohydrates and protein (rich in essential amino acid – lysine). Its gluten free and acts as a diuretic, therefore helps in digestion.
- Ragi: good source of calcium, also rich in sulphur containing amino acid – methionine, high in soluble and insoluble dietary fiber.
- Green gram whole: rich in arginine, branched chain amino acid. Germination helps in reducing flatulence and aids better and easy digestion.
- Soya beans: rich in linoleic and lenolenic fatty acids, rich in poly unsaturated fatty acids (PUFA), contains compunds which are thought to suppress carcinogenesis – Bowman dirk inhibitor, inositol hexa phosphate (phytic acid), phytosterol B, sitosteraol and isoflavones. Phytoestrogen as genstein and diadzecin.
- Provides antioxidants- vitamin A and E
- Fairly good source of mineral- Zinc and Calcium
- Rich in soya polysaccharide fiber (SPF) which are degraded by intestinal micro flora to provide short chain fatty acid (mainly butyrate) which are major fuel for intestinal villi.
- Till (Sesame/gingely seeds): very good source of manganese, copper, magnesium, calcium , iron, thiamine, zinc and dietary fiber with cholesterol lowering effect and prevent high blood pressure. Prevents oxidative damage.
- Flax seed: rich in alpha lenolenic acid (ALA), the essential fatty acid belonging to group of omega -3 fatty acid.
- Sugar: concentrated and instant source of energy, easily digestible and easily absorbed. Improves the acceptability of the products by improving the taste.
- Skim milk powder: it is used in improving protein quality as it contains all essential amino acids allowing reduction in total amounts of proteins which could have potential metabolic advantage and increases soluble vitamins. Skim milk powder is used as a saturating agent to block nonspecific binding sites on supports like blotting membrane (nitrocellulose) preventing binding of further detection reagents. The major protein component of milk- casein is responsible for most of the binding site saturation effect (Journal of Nutrition, 2008).

Preparation of LCEF

Preparing Enzyme Rich flour:-

Soaking: the required quantity of wheat, ragi, mung, soya beans were soaked in water over night, enabling the grain to swell up and thus help inactivation of the enzyme in the grain. Soaking helps in reducing oligosaccharide of the raffinose family and thus reduces the chances of flatulence. It also reduced the amount of phytic acid, which is an anti-nutrient factor which can affect the absorption of various nutrients.

Germination: the grains are drained, packed in muslin cloth and allowed to germinate. This allows maximum synthesis and activation of various beneficial enzymes. During germination the dormant enzymes like cystases and pectinases are released which breakdown the cell walls increasing the availability of protein and minerals. Germination brings about hydrolysis of protein into its immune modulatory compounds like glutamine and arginine. Starches and proteins are converted into simpler substance and availability of essential amino acid increases. Germination reduces or eliminates trypsin inhibiting factors and toxins. The amount of riboflavin, niacin, folic acid, choline content is increased.

Drying and roasting: the grains are then sun dried, which help in complete dehydration. Roasting imparts a flavor and also brings about dextrinization making it easy to digest, thus im[proving the quality and biological value of proteins.

Removal of rootlets: the rootlets that are developed in germination are removed which are non-caloric fiber portion, helps reducing the bulk and increasing the caloric content (CFTRI, Clinical Trials). This was all then grinded to form a powder.

PHASE 2:

Standardization: the formulated formula was then standardized to prepare a feed similar to other nutritional products, which could be fed to patients. 50gm of developed feed formula was developed in 190ml water (boiled+cocoled) to make 200ml feed.

PHASE 3:

Evaluation of nutritive value and cost: the standardized feed was then evaluated for its nutritive value (source of calculation- Nutritive value of Indian Foods, by C.Gopalan, BV Rama Sastri and SC Balasubramanian) and cost benefit analysis was carried (taking into consideration the then market price of the ingredients.)

PHASE 4:

Nutrition appraisal of LCEF/ Commercial feeds

A whole day's diet plan was formulated for patients with head and neck cancers using LCEF and commercial formula, which is more commonly used for patients at hospital. The nutritive values of both these products were analyzed. Two groups of subjects from head and neck unit underwent surgery with 8-10 days hospital stay. Experimental 30 samples were provided with LCEF feeds through Nasogastric Feeding. Control 30 sample were feed with commercial formula. Anthropometric measurements using weight, mid upper arm circumference (MUAC) and BMI were taken pre and post treatment using standardized method. The biochemical parameters using serum total proteins, serum albumin, and hemoglobin were taken pre and post treatment. The results obtained were evaluated to determine the efficacy of LCEF.

Table 7: Diet Content

	Experimental (sample size-30) LCEF powder in 190ml water	Control (sample size-30) Resource Plain in 190ml water
Calories (kcal)	1617	1668
Proteins (g)	56	55
Fats (g)	69	69.7
CHO (g)	244	244

PHASE 5:

The overall acceptability of this product was seen on 50 head and neck patients for five days undergoing radiation therapy at the hospital. These patients were randomly selected and feed before taking radiation dose.

RESULT AND DISCUSSION

A high calorie high protein enteral formula was designed in exchange with other commercial supplements available in market. This formula, with its similar nutritional contents, easy to prepare and cost effective could also bring emotional comfort to the patient.

Table 8: Low Cost Enteral Formula

Ingredients	Wheat (whole)	Rice (milled)	Ragi	Mung (whole)	Soya bean	Till	Flax seed	Sugar	Skim milk powder	Total	Per 100g
Amount (g)	300	100	100	300	100	100	100	200	100	1400	
Energy (kcal)	1038	345	328	1002	432	563	530	800	496	5534	395
Protein (g)	35.4	6.8	7.3	72	43.2	18.3	20.3	-	25.8	229.1g	16.4g
CHO(g)	213.6	78.2	72	170.1	26.9	25	28.9	200	38	846.7g	60.5g
Fats (g)	4.5	.5	1.3	3.9	19.5	43.3	37.1	-	26.7	136.8g	10g
Na (mg)	51.3	-	11	84	-	-	-	-	-	136.3mg	9.8mg
K (mg)	852	-	408	2529	-	-	-	-	-	3789mg	270mg
Ca (mg)	123	10	344	372	240	1450	170	-	95-	3659mg	261mg
P (mg)	918	160	283	978	690	570	370	-	730	4699mg	335mg
Iron (mg)	15.9	0.7	3.9	13.2	104	9.3	7.9	-	.6	61.6mg	4.42mg
Fiber (mg)	3.6	0.2	3.6	12.3	3.7	2.9	4.8	-	-	31.1mg	2.2mg
Zinc (mg)	8.1	1.4	2.3	9	3.4	12.2	-	-	-	36.4mg	2.6mg
Mg (mg)	414	90	137	381	170	-	-	-	-	119.7mg	85.5mg

Table 9: Cost Analyses

Name of Company	Products	Package/Quantity	Cost Rs.	Dilution	Cost per feed Rs.
Nestle	Resource (plain)	400gms in 1 tin	342	50gms/200ml water	42.75
	Resource HP	200gms in 1 tin	168	15gms/200ml water	12.6
	Resource (Diabetics)	200gms in 1 tin	220	22.4gms/200ml water	24.6
	Resource (Renal)	200gms in 1 tin	160	22gms/200ml water	17.6
	Resource (Hepatic)	200gms in 1 tin	215	26gms/200ml water	28

	Impact	1 box=61×4	320	1 sachet/206ml water	80
	Nevosource peptide	200gms in 1 tin	170	25gms/85ml water	21.3
Abbot	Ensure	400 gms in 1 tin	358	43gms/170ml water	34
Glaxo Smith	Actibase (Neutral)	200gms in 1 tin	255	18gms/200ml water	22.95
LCEF		100gms packet	18	6tsp(50gms) /200ml water	9.00

Table 10: Comparison of LCEF with other commercial products

	Units	Fit kid	Kid pro	Pedia sure	Resource High Protein	Resource plain	LCEF
Energy	Kcal	311	400	470	355	446	395
Protein	gms	33	24	14.1	41	15.71	16.4
Fats	gms	3	8	23.4	2	15.71	10
CHO	gms	38	58	50.05	48	61	60.5
Sodium	mg	-	500	181	500	357	98
Potassium	mg	-	900	512	800	660	270
Calcium	mg	200	800	386	500	223	261
Phosphate	mg	95	500	240	900	223	335
Magnesium	mg	160	180	78	-	89.3	85.5
Iron	mg	2.5	3	5.5	15	4	4.42
Zinc	mg	1	1.25	3.5	4.5	3.3	2.6

Diet Plans for experimental and control groups:
Experimental Group (Sample size -30)
6:30 am : 1 glass water + 6tsp LCEF powder
8:30 am : 1 glass milk + 3tsp sugar
10:30 am : 1 glass milk + 3tsp sugar
12.30 pm : 1 ½ glass Blended soup
3:30 pm : 1 glass water + 6tsp LCEF powder
5.30 pm : 1 glass milk + 3tsp sugar
7:30 pm : 1 ½ glass Blended soup
9:30 pm : 1 glass milk + 3tsp sugar
Control Group (Sample size -30)
6:30 am : 1 glass water + 6tsp Resource (plain)
8:30 am : 1 glass milk + 3tsp sugar
10:30 am : 1 glass milk + 3tsp sugar
12.30 pm : 1 ½ glass Blended soup
3:30 pm : 1 glass water + 6tsp Resource (plain)
5.30 pm : 1 glass milk + 3tsp sugar
7:30 pm : 1 ½ glass Blended soup
9:30 pm : 1 glass milk + 3tsp sugar

Table 11: Nutrition Appraisal of LCEF and Commercial Feeds

	Experimental group				**Control group**			
Time	Cals (kcal)	Pro (g)	Fat (g)	CHO (g)	Cals (kcal)	Pro (g)	Fat (g)	CHO (g)
6:30 am	197.5	8.2	5	30	223	7.3	7.3	30
8:30 am	199	6.6	12	24	199	6.6	12	24
10:30 am	199	6.6	12	24	199	6.6	8.2	24
12:30 pm	213	7	5.5	44.2	213	7	5.5	44.2
3:30 pm	197.5	8.2	5	30	223	7.3	7.3	30

5:30 pm	199	6.6	12	24	199	6.6	12	24
7:30 pm	213	7	5.5	44.2	213	7	5.5	44.2
9:30 pm	199	6.6	12	24	199	6.6	12	24
Total	**1617**	**56.8**	**69**	**244.4**	**1668**	**55**	**69.7**	**244.4**

The age of patient in the study ranged from 25-71 yrs. of age and their income level ranged from 200 rs per month to 2,500 rs per month.

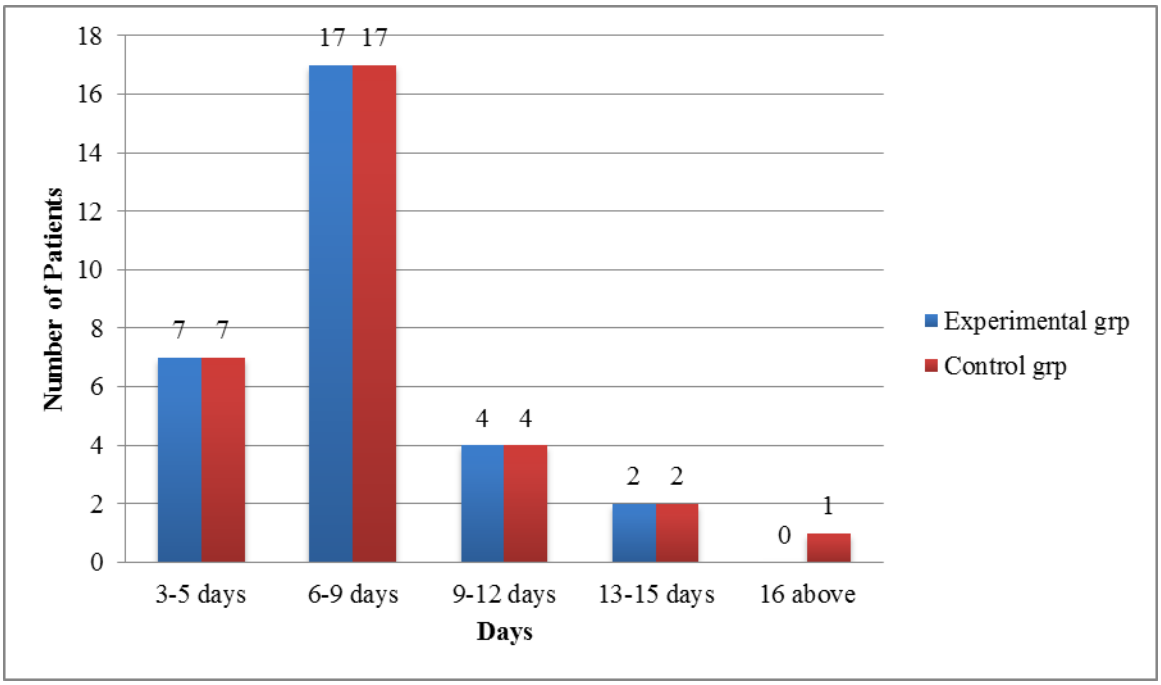

Figure 1: Hospital Stay of the Patient

As shown in the above figure, the mean hospital stay among the experimental group was around 7.63 and among control group was around 7.8 days. Therefore mean hospital stay for both the group was around 8 days. Thus, LCEF decreased the hospital stay of the experimental group.

Table 12: Baseline Biochemical Parameter

	Experimental grp	Control grp
Hemoglobin (g/dl)	10.25	10.53
Total Protein (g/dl)	5.91	5.94
Serum Protein (g/dl)	2.56	2.79

It was observed that in baseline biochemical parameters there was not much difference between the two groups.

Table 13: Baseline Anthropometric Characteristics

	Experimental grp	Control grp
Weight (kg)	48.4	55.2
MUAC (cm)	24.2	24.9
BMI (kg/m^2)	19.45	20.6

Baseline anthropometric characteristics were found to be similar in both the groups.

Table 14: BMI Classification

Below 17	Severely malnourished
17-18.5	Moderately malnourished
18.5-25	Well nourished
Above 25	Obese

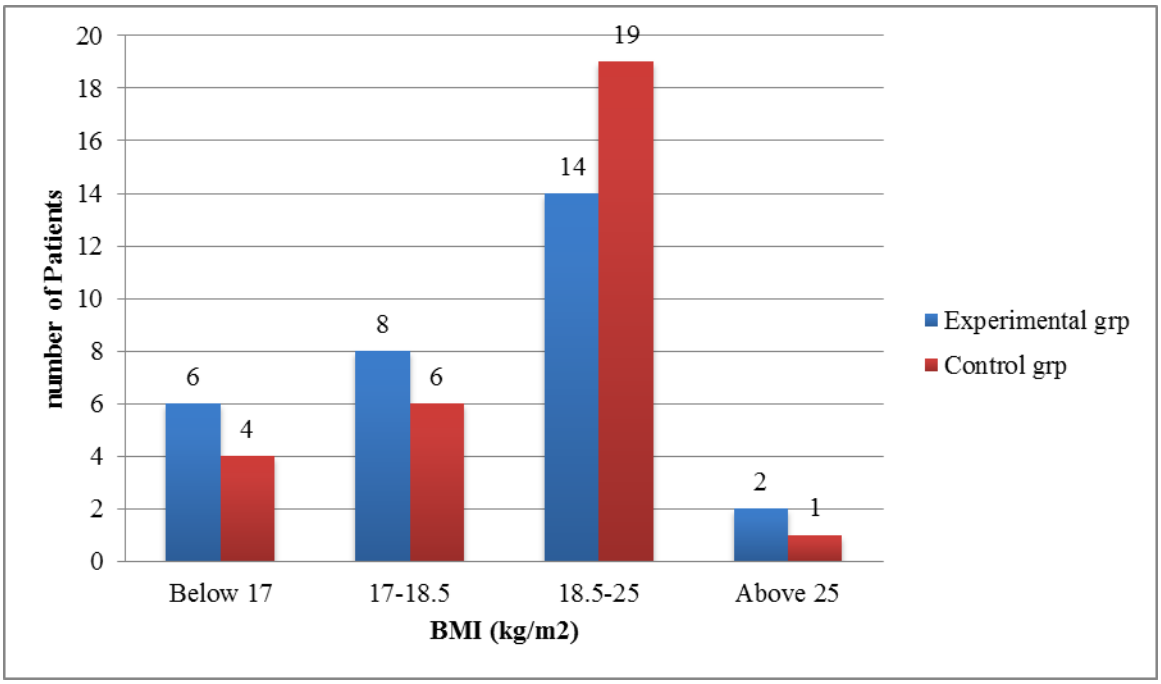

Figure 2: BMI of Patients

In the above figure, among the experimental group, out of 30 patients, 6 (20%) were severely malnourished, 8 patients (26.7%) were moderately malnourished, 14 patients were well nourished and only two were obese.

Among control group, out of 30 patients 4 were (13.3%) were severely malnourished, 6 were (20%) were moderately malnourished, 19 patients (63.3%) were well nourished and only 1 patient was obese.

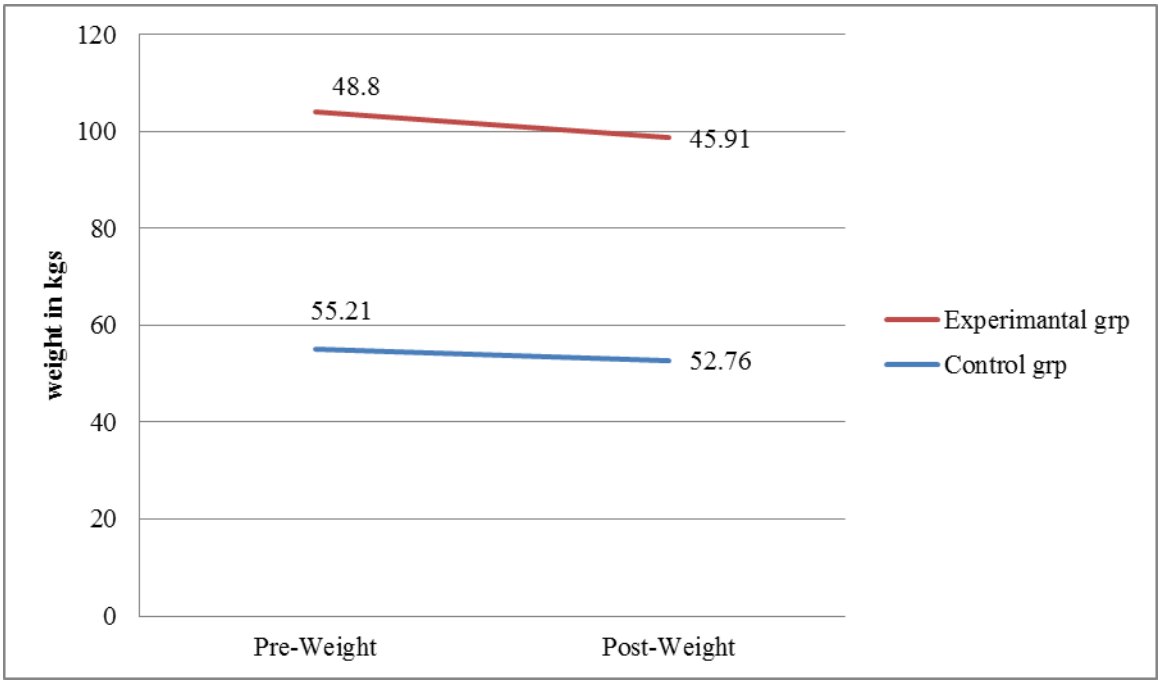

Figure 3: Weight among Patients

As seen in figure 6, the mean weight of the experimental group pre surgery was among 48.8 kgs which decreased to around 45.91 kgs post-surgery after the feeding period. Similarly among the control group, the mean weight of patients pre-surgery was 55.21 kgs, which decreased to around 52.76 kgs after the feeding period.

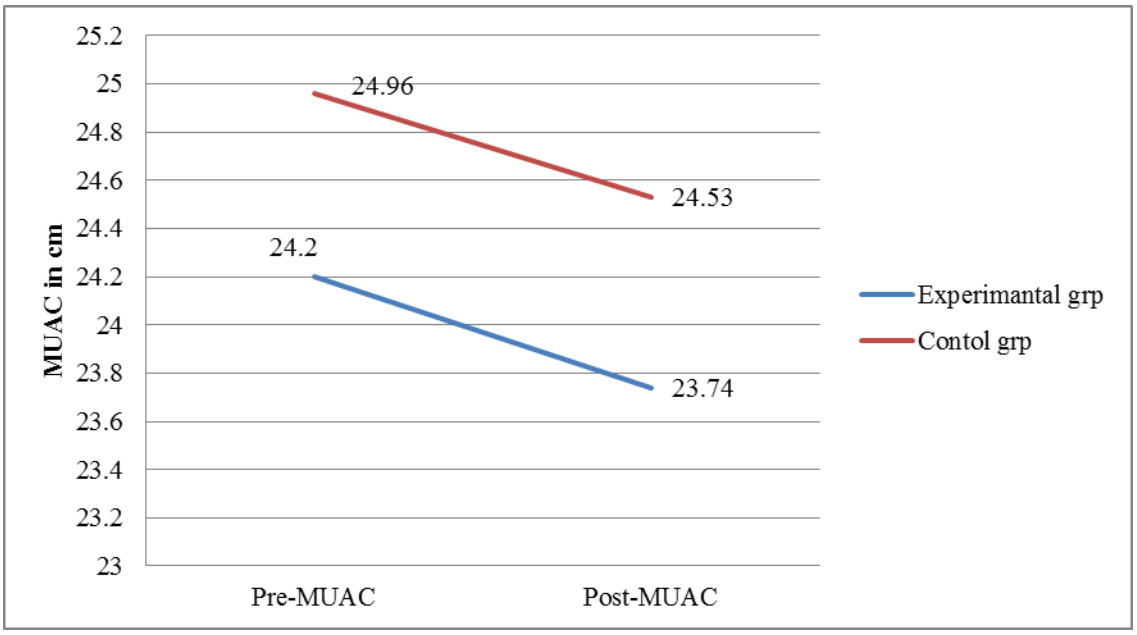

Figure 4: MUAC of Patients

As seen in the figure 4, the mean MUAC of 24.2cm among experimental group decreased to 23.74cm during hospital stay. Similarly the mean MUAC among the control group deceased from 24.96cm to 24.53cm.

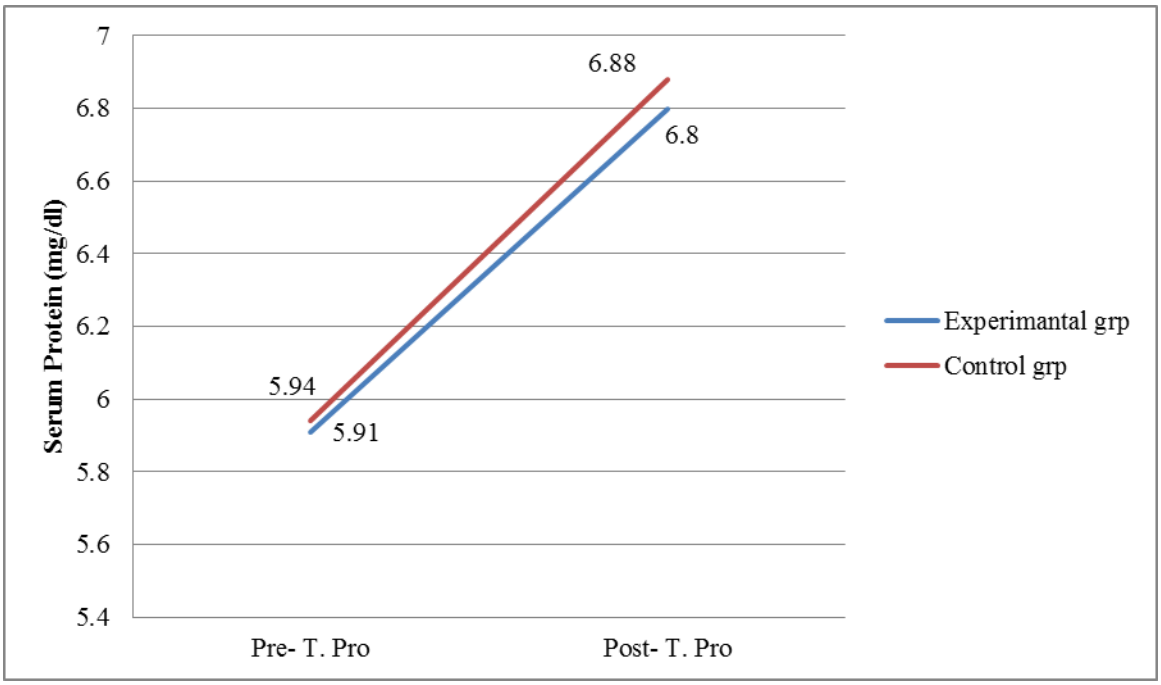

Figure 5: Serum Protein Levels among Patients

The mean serum total protein levels among the experimental and control group were 5.91g% and 5.94g% which increased to 6.8g% and 6.88g% respectively, as shown in figure 5.

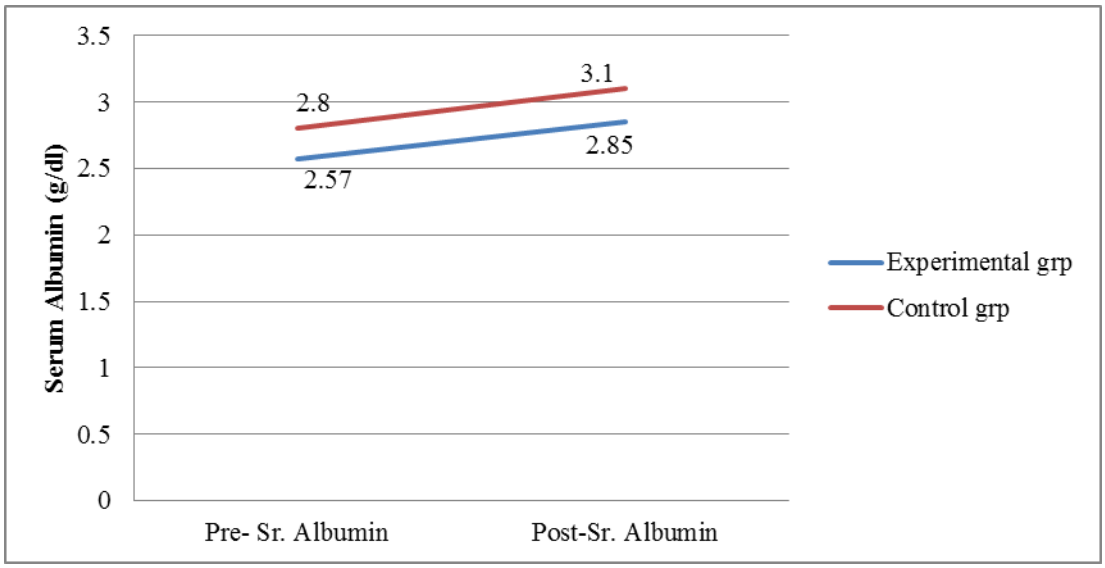

Figure 6: Serum Albumin Levels among Patients

As observed in figure 6, the mean increase in serum albumin levels among the patients of the experimental group was from 2.57 g% to 2.85g% and among the control group was from 2.8g% to 3.1 g%.

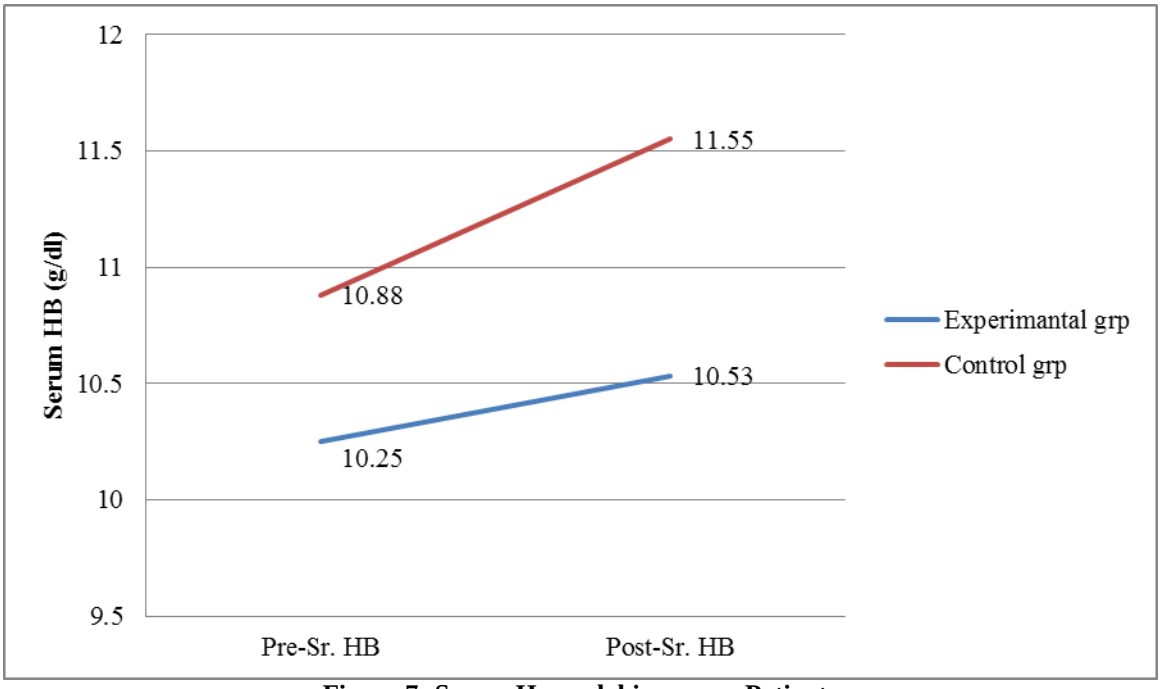

Figure 7: Serum Hemoglobin among Patients

There was increase in mean serum hemoglobin among both the groups as shown in figure 7.

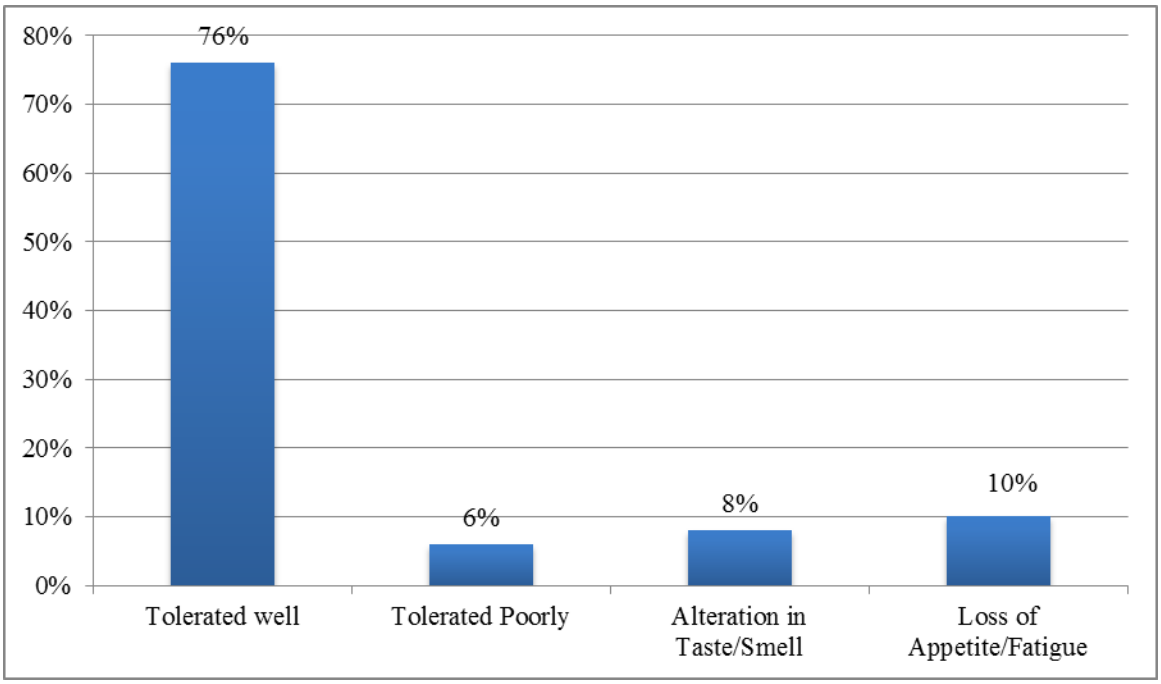

Figure 8: Patient's Tolerance to feed

76% (n=38) tolerated the feed well, 10% (n=5) experienced the feeling of fullness post feeding, 8% (n=4) observed gastrointestinal discomfort and only 6% (n=3) tolerated feed poorly as they felt dryness of mouth and throat.

IV. SUMMARY AND CONCLUSION

Commercial formulas are expensive; it may not be feasible to the patients to continue on commercial formulas. LCEF is cheaper, easy to prepare and provides comfort to the patient. As seen in the study the outcomes of LCEF feeds were similar to those obtained from commercial feeds, but at a cheaper rate. It can be easily prepared at home with nutrients in natural form. So that later adaptation to normal foods becomes easy. It has a consistency that would easily pass through the feeding tube. The overall acceptability and tolerance was good.

ACKNOWLEDGMENT

I would like to thank, the Divine Almighty and his presence with me throughout the study, which has pulled me out when I found myself in a heap of confusion and frustration. It was indeed strong in him, which enabled me to complete this work.

Since the year 2006, it was now the late Director of Tata Memorial Centre Dr. K.A. Dinshaw, encouraged to conduct this small study in the hospital. This in 2013 was accepted by the present Director R.A. Badwe, who encouraged putting up as IAEA-CRP Project, who permitted me to try further, on the patients. I am therefore thankful to both the Directors.

I am grateful to Dr. Jagmeet Madan, the principal of SVT College of Home Science and the President of Indian Dietetic Association, Mumbai Chapter, who in spite of her tight scheduled has been readily available to give me continuous guidance, support and help needed throughout the study.

It would not be right on my path, if I don't acknowledge Dr. Ganesh, HOD statistic and record department, Tata Memorial Hospital for analyzing the results. Also all the patients, the cornerstone of my study for their and co-ordination and trust which made my study a success should not be forgotten.

Last but not the least, my colleagues Mrs Purabi Mahajan and T.Y. Shivshankar and the Food service Department on the whole.

I would like to express my gratitude to my dear husband Mr. Bharat S Nair and my two sons and all other family members for providing all the help needed and being a source of inspiration and motivation throughout the project.

REFERENCES

[1] Jain, 2003, Nutritional parameters in children with malignancy. Indian Pediatrics 40:976-984.

[2] Bloch AS (ed) Nut Mgt. of Ca Patients, Rochvi ASPEN: A Cancer Guide, 1990.

[3] www.Trigan.com/catyps.htm, 2000.

[4] Northern Cancer Network, Head and Neck Cancer Nutritional Guidelines.

[5] Soube WW et al 1985, glutamine metabolism by intestinal tract J.Par.Ent.Nut. 9:608-617.

[6] Langstein and Norton, 1991.

[7] Dewys WD et all 1980, Prognostic effect of weight loss prior to chemotherapy in treatments. American J med 60:49.

[8] B. Srilakshmi, 2002, Food Science.

[9] Krause and Mahan, Food Nutrition and Dietetics, 1996

[10] Journal of Nutrition, 138, January 2008)

[11] Nutritive Value of Indian Foods, C. Gopalan, B.V. Rama Sastri, and Balasubramaniam, Rivised by and Updated by B.S Narasinga Rao, Y.G. Deosthala and K.C. Pant, ISBN:8123019789.

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