INDIGENOUS PRODUCTION OF READY-TO-USE THERAPEUTIC FOOD TO ADDRESS SEVERE ACUTE MALNUTRITION IN INDIAN CHILDREN

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Abstract- This article describes a production unit narrating the processes used in constructing a demonstration unit for making MNT (Medical nutrition Therapeutic) food used during pilot facility trails at LTMCGH facilities in Sion-Mumbai, India. The unit served the requirements of making RUTF kind of products used in clinical trials during 2011-14. The production facility demonstrated that a production unit can be sustained using local ingredients and local skills are adequate to make Ready-to-use food formulations necessary to manage a strategy of administering foods in the "malnutrition-handling" programmes for health-care.

Index Terms- Severely acute malnutrition (SAM), Ready to use therapeutic food (RUTF), Medical nutrition therapy (MNT), Malnutrition.

I. Introduction

Severely malnourished with age under-five children in India are estimated to constitute 6.4%, in addition to 19.8% who are moderately malnourished according to the National Family Health Survey (NFHS) – 3[(1)]. This translates to about 8.1 million children with severe acute malnutrition (SAM) in India. Currently available facilities for hospitalized care of children in India would be inadequate even if they were utilized exclusively for the treatment and rehabilitation of children with SAM [(2)] .Hence there is a need for home-based state-of-the-art care.

II. What is MNT ?

Children with severe acute malnutrition need safe, palatable foods with a high energy content and adequate amounts of vitamins and minerals[(3)].MNT i.e Medical Nutrition Therapy is a form of ready-to-use therapeutic food (RUTF) which is calorie dense and protein rich and fortified with essential micro-nutrients required for optimal growth and weight gain. It is a paste like material which includes peanut paste, skimmed milk powder, powdered sugar, soybean oil ,micronutrient mix and emulsifier. It is stable at room temperature and the shelf life, if well packed, is 6 months. The particle size should be less than 200 microns. WHO recommends MNT as a gold standard for management of severely malnourished children. Government of India has not approved use of commercialy produced RUTF for the management of malnutrition. Hence with the help of IITB, Mumbai alongwith technical expertise from Toddler Food Partners (TFP) the indigenous production unit, first of its kind in India, was set up at Urban Health Centre of Lokmanya Tilak Medical College and General Hospital, Sion, Mumbai. This article shares our experience of making MNT in the Hospital complex for treatment of SAM children.

III. PRODUCTION OF MNT

MNT production involves steps such as: screening of peanuts, grinding them into peanut-butter and then mixing the ingredients (milk powder, icing sugar, oil, emulsifier and micronutrients) followed by fine grinding process and then packaging. The ingredients used for production of MNT is peanuts, skimmed milk powder, soybean oil, powdered sugar, micronutrient mix and emulsifier are also sourced within Indian market and available throughout the year. The steps in the process of production include:

Step 1: Checking the moisture of the roasted dehusked peanuts using moisture meter. Acceptable moisture - less than 4%.

Step 2: Aflatoxin is probably the most common and widely known mycotoxin contaminant. It is produced by moulds Aspergillus. flavus and Aspergillus. parasiticus. Foods that are commonly affected include all nuts, especially groundnuts. Aflatoxin B1, B2, G1 and G2 refers to toxins which give fluorescence blue (B) or green (G) under ultraviolet light[(4)]. For screening peanuts under UV lamp of 260nm for aflatoxins. The peanuts are spread over the plain tray and lamp is moved manually over the peanuts in a darkroom. Aflatoxin afflicted peanuts give yellow luminescence on the peanut to the naked eye. They are removed manually.

Step 3: Accepted peanut-lot is ground into fine-paste with the help of motorized grinder as depicted in Fig.1. These steps can be omitted (if so necessary) by directly buying peanut paste from the manufacturer with the aflatoxin analysis report.

Step 4: weighing of all the ingredients on a digital weighing scale with precise accuracy upto two digits. Weighing scale needs to be calibrated on monthly basis.

Step 5: mixing of the ingredients. First the peanut paste and the soybean oil along with emulsifier (which is dissolved in small amount of warm oil) are mixed in the planetary mixer followed by other dry ingredients such as skimmed milk powder, powdered sugar and micronutrient mix for a duration of 20 minutes. After mixing, the product becomes thick bulky mass.

Step 6: the mixture undergoes a second pass through the grinder to get a fine homogenous paste to achieve the particle size of less than 200 microns.

Step 7: final product is packaged in 92gm cups with the help of semi automatic filling, sealing and printing machine. Packaging of MNT can also be done in sachet which is widely followed for RUTF packaging in International markets.

Step 8: Sealed cups are stored at room temperature in cardboard boxes (secondary packaging) with a capacity to accommodate 32 cups/box.

IV. Ingredients

The formulation of MNT (RUTF) was derived from F-100 and uses same ingredients with addition of peanut paste [5]. Recipe for MNT is given below in table 1

Ingredients	% weight
Peanut paste	25
Skimmed milk powder	24
Powdered sugar	28
Soybean oil	20.8
Micronutrient mix	1.6
Emulsifiers	0.6

Table 1. Recipe for MNT.

a) Peanut paste- Roasted dehusked peanuts are ground in the motorized grinder to form a paste. Peanut paste (with 100% peanut and no preservative no salt) directly from commercial food processing company can also be used.

b) Skimmed milk powder-From co-operative Milk Marketing Federation or other co-operatives brands that is available in the market making the availability of the milk powder possible everywhere in the country.

c) Powdered sugar: Commercial sources of sugar can be used to make MNT. The sugar should be in the powdered form also known as icing sugar to achieve the particle size of less than 200 microns.

d) Soybean oil- Several types of oil are available in the market which is made by standardized method. Soybean oil would be especially helpful for a diet, it contains essential fatty acids like omega-6 fatty acid called linoleic acid (Soybean oil is about 50% linoleic acid) and monounsaturated fat (soya bean oil is approximately 25% monounsaturated)[5].

e) Micronutrient premix- The premix contains20 minerals and vitamins required for SAM children as per WHO recommendation. It is available commercially. The content of the premix is listed in Table 2,[7]

Nutrient	Basis per 100 gm. of premix	
Vitamin A	57	mg
Vitamin D	1	mg
Vitamin E	1.25	g
Vitamin K	1.3	mg
Vitamin B1	37.5	mg
Vitamin B2	116	mg
Vitamin B6	37.5	mg
Vitamin B12	110	mg
Vitamin C	3.3	g
Biotin	4.1	mg
Folic acid	13	mg
Niacin	332	mg
Pantothenic Acid	194	mg
Potassium	36	g
Magnesium	587	mg
Iron	704	mg
Zinc	717	mg
Copper	92	mg
Iodine	5	mg
Selenium	1.54	mg

Table.2. Composition of micronutrient premix

f) Emulsifier: If there are any issue of oil separation and texture, emulsifiers can be used. Dimodan HP-1 is a distilled monoglyceride made from edible, fully hydrogenated palm based oil. It provides creamy texture, high filling temperature, short set time and good oil holding capacity [8].

V. Scale of production

During the initial phase of production when the requirement of MNT was less, the production capacity was, 2 batches per day (11kg each) yielding 3,520 cups/month.

The machines used in this phase were manually operated. The production equipment used is shown in Table 3.

Production Equipment	Quantity
Motorized grinder	1
Planetary mixer	1
Peddle filling machine	1
Sealing machine	1

Table.3. Equipment used for production at the initial phase.

During this phase, one grinder was used for process of grinding the peanut and for the fine grinding process (post mixing of all ingredients). After mixing the ingredients and the fine grinding process the final mixture is added in the peddle-filling machine which was operated manually. After filling, the cups were sealed with aluminum foil in manual sealing machine and later stickers with batch number and manufacturing date etc were stuck on the cups. The whole process of packaging itself would take around 3 hrs. The manual packaging machine constrained the scale of production.

Eventually when the requirement of MNT scaled up, the production required upgradation and the manual filling machine and manual sealing machine were replaced with semi-automatic filling sealing and printing machine. The time required for packaging with the help of this machine was cut down to 1hr 30minutes per batch.

In the later stages, peanut paste which was prepared in the production unit itself using dehusked, screened, roasted peanut was replaced with peanut paste manufactured commercially. This peanut paste has been checked and certified for no aflatoxin and moisture less than 2%. Procuring of peanut paste commercially has cut down the process of screening and grinding of peanut. After the mixing, for the fine grinding process one additional grinder was added to the production unit. The current maximum capacity of the unit with these machineries is, 12,800 cups/month. The scale of operations and the costs of production vary by the production model. Skimmed milk powder accounts for nearly 46.4% of the ingredient costs [9] Fig. 3. Cost of MNT from this small scale production unit is Rs 300/kg.

VI. Quality Control

Even small scale production should adhere to the set standards for food production [10][11].The macro and micronutrient analysis is done annually. Toxins and pesticide assay needed to be done biannually. Microbiology assay for contaminating microbes like Salmonella, Staphylococcus, Chronobacter, Coliforms, yeast and moulds from finished product and aflatoxin assay with pooled sample of in-house prepared peanut paste from every batch.

Quality check is also achieved by adopting few operative procedures that are internationally accepted as standard for food production. E.g., epoxy flooring, calibration of weighing scale, monthly fumigation, avoiding water source in the production room, restricted entry of visitors, proper storage of raw material and finished product.

VII. Sustainability

Every NRC should be equipped with a small scale production unit in the areas where SAM is rampant. This model will cover both facility as well as community based care for SAM in that geographical location. This production process does not require skilled labor or advanced machineries. The amount of MNT produced can be controlled to meet the needs. It gives the opportunity to use locally available ingredients and reduces the transportation cost. It also provides job opportunity. In country like India where commercial RUTF is still not approved by the government, indigenously produced RUTF is the answer for the state-of-art management of SAM children.

VIII. Conclusion

The experience of making indigenous MNT in the public hospital/premises and using for facility based management of severely malnourished children has been narrated.

The articles elaborate the detailed unit operations used in making RUTF kind of product. The experience consolidate that similar products can be locally made and gainfully used.

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Machinery used at production unit

Digital moisture meter

Portable UV lamp

Digital Weighing Scale

Motorized Grinder

Planetary mixer

Semi-automatic filling-sealing-printing machine

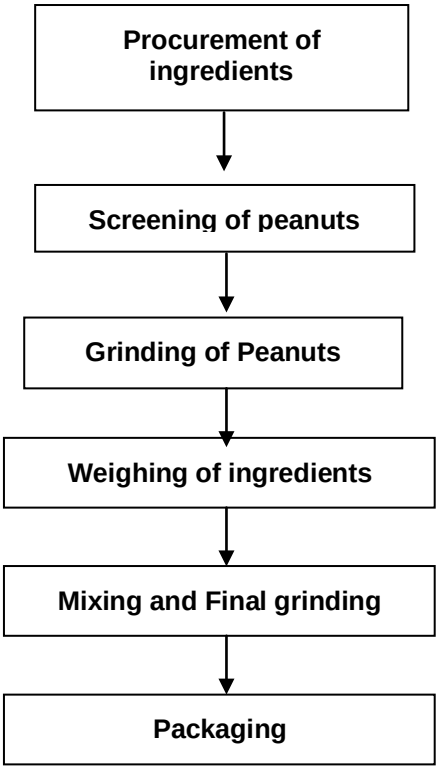

Fig 1: Flow-chart of unit operations.

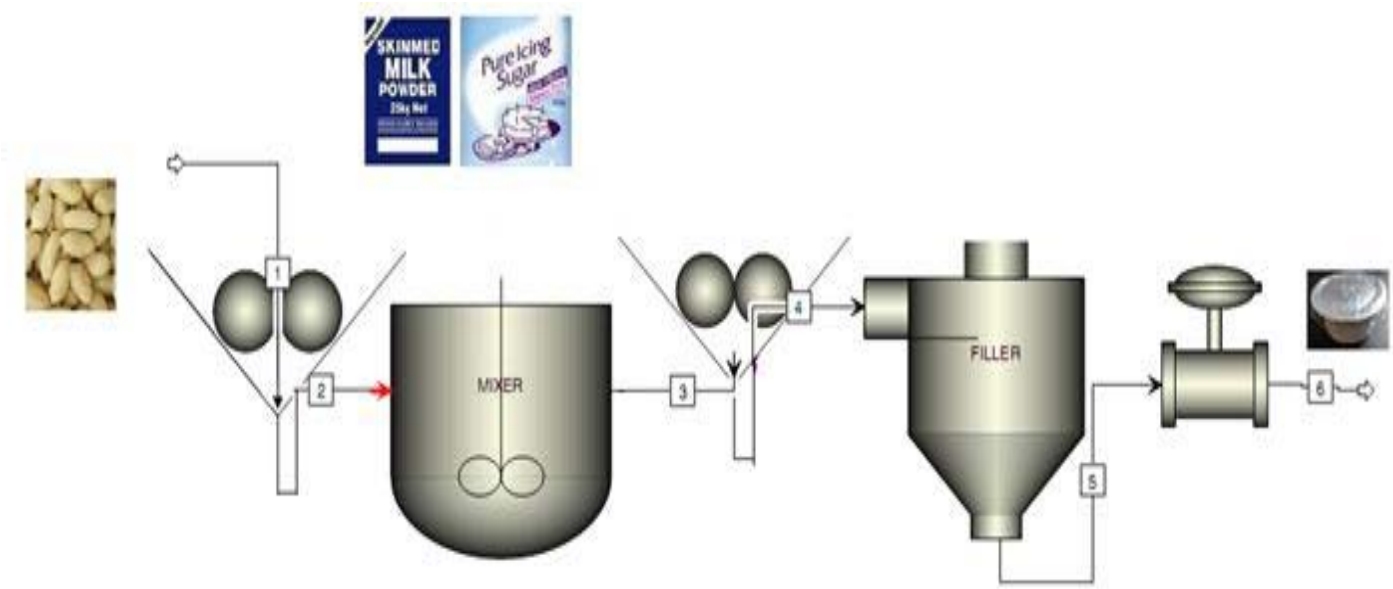

Fig.2:Flow sheet of batch production unit for making Nutritious Foods using local Ingredients

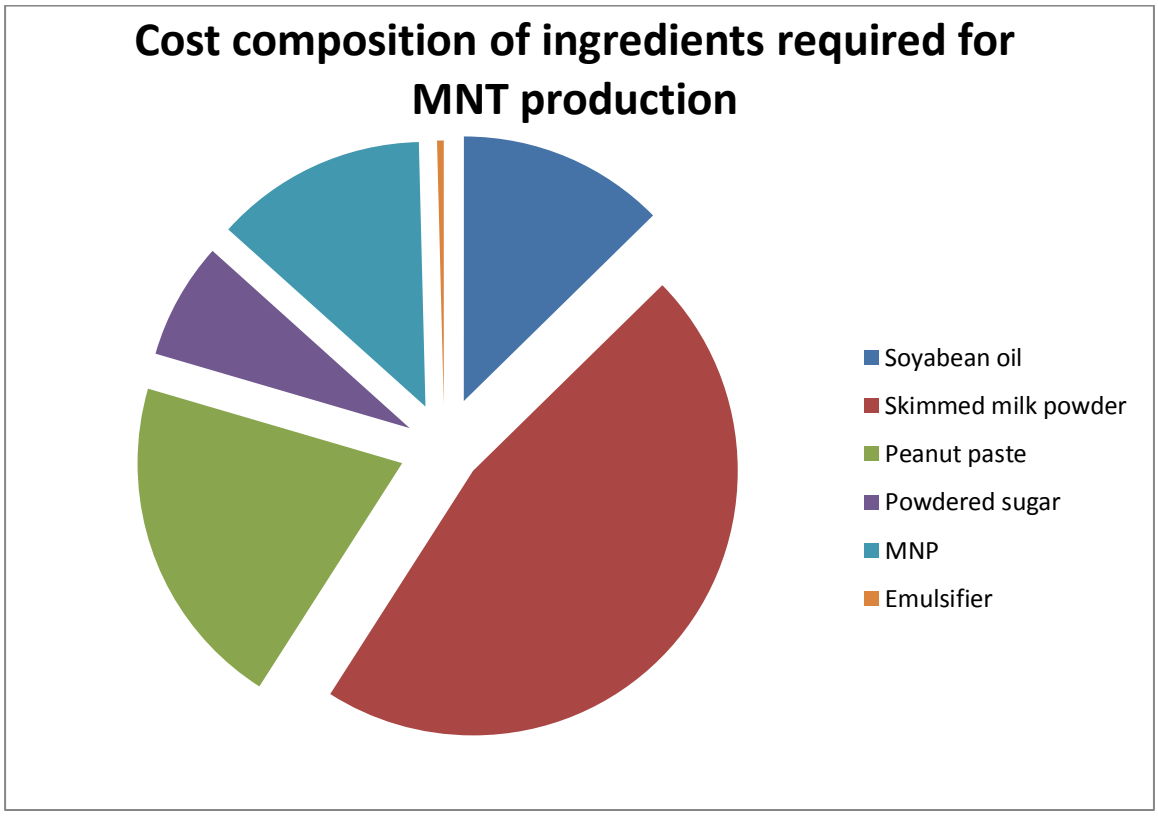

Fig. 3