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A MINI REVIEW ON LIPID BASED NUTRIENT SUPPLEMENTS (LNS) AND THEIR ROLE IN ACCELERATING RECOVERY FROM MALNUTRITION IN CHILDREN

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Abstract: Present economic situations in some underdeveloped countries indicate a lack of proper supply chain and usage of RUTF (Ready to Use Therapeutic Food) or LNS (Lipid Based Nutrient Supplement) for improving child malnutrition. This mini review attempts to demonstrate how lipid-based nutrient supplements can aid in the recovery of children suffering from malnutrition, which is the leading cause of death among children and adolescents worldwide. Lipid Based Nutrient Supplements, or LNS, are typically utilized in emergency situations such as food shortages, medical problems, and so on. Because of their simple formulation and basic characteristics they are straightforward to use and appetizing to children. Production parameters of this supplement are very crucial in maintaining the shelf life and feasibility of the various missions around the world. LNS dosage is also discussed in this mini review paper along with factors upon which a LNS should be evaluated.

Keywords – LNS, malnutrition, children, emergency

I. INTRODUCTION

In a recent research, the World Health Organization (WHO) estimates that there are 178 million malnourished children in the world, with 20 million of them suffering from severe malnutrition; undernutrition is responsible for 3.5 to 5 million yearly fatalities among children under the age of five. Malnutrition occurs when the amount of one or more macronutrients available to body tissues is insufficient to maintain optimal bodily functions, and this is often accompanied by multiple micronutrient deficiencies. Malnutrition is a broad concept that includes many clinical

conditions such as kwashiorkor, marasmus, marasmic kwashiorkor, emaciation or stunting, and micronutrient deficiencies [1, 2]. It also involves a greater risk of illness, mortality, and delayed cognitive development, all of which contribute to low adult earnings, poor economic growth, and poverty transmission across generations [17]. Malnutrition is usually multifactorial, resulting from a vicious cycle of infections and malnutrition, which is exacerbated in low and middle-income nations by food insecurity and poverty. Natural and man-made crises, such as war, drought, and starvation, compound the situation. [3]. Overall, undernutrition is a leading cause of immunodeficiency worldwide, primarily affecting infants, children, adolescents and the elderly, increasing the risk of infections. Iron, iodine, vitamin A, and zinc deficiencies are still important public health issues in underdeveloped nations, while vitamin C, D, and B deficiencies have decreased significantly in recent decades. [4, 5]. The effectiveness of ready-to-use therapeutic meals (RUTF) for the treatment of severely malnourished children has fueled interest in using lipid-based diets to tackle child malnutrition [6]. Ready-to-Use Therapeutic Foods (RUTF) and Ready-to-Use Supplementary Foods (RUSF) are energy-dense, micro nutrient-rich pastes referred to as Lipid Nutrient Supplements together (LNS). During seasonal lean seasons and situations where under-nutrition is a concern, these specially prepared products are generally provided to children aged 6 to 59 months. The goal of these meals is to help newborns and young children gain weight quickly while also providing necessary vitamins and minerals throughout these key stages of physical and mental development [7]. Figure 1 depicts that how malnutrition affects growth in children.

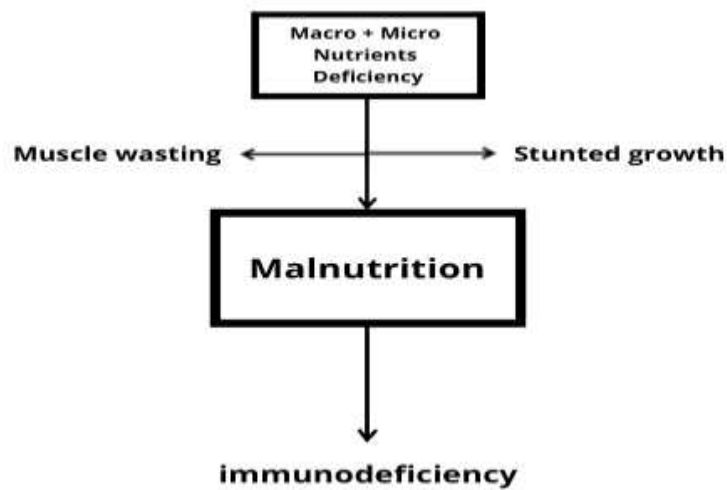


Figure 1 - How malnutrition affects growth in children

1. Composition

RUTF is a blend of lipid-rich and water-soluble meals that is homogenous [9]. This food should be soft or crushable, palatable and easy for children to eat without any preparation. It should be noted that milk is an expensive element in conventional RUTF [19]. At least half of the proteins contained in the product should come from milk products [8]. Small particles of protein, glucose, vitamins, and minerals are dispersed throughout the lipids, which exist as a viscous liquid. 30 percent powdered whole milk, 28 percent powdered sucrose, 15 percent vegetable oil, 25 percent peanut butter, and 1.6 percent CMV make up the usual RUTF composition (w/w). [9, 10].

1.1 Production

The ready-to-eat therapeutic meals were originally produced using peanuts, milk, oil, and micronutrients (for example, Plumpy Nut and BP 100). Groundnut is prized for its high energy content, which comes from oil (48–50%), protein (25–28%), and carbs (10–20%) in the kernels [20]. Alternative protein sources, such as a mix of grains and pulses, soy flour, soy protein concentrates, or a cheaper animal source protein, such as whey protein concentrates, have since been tested [3]. The lipid components of RUTF

are swirled and often heated first, and then the powdered ingredients are gently added to the lipids while vigorous stirring continues. After all of the powdered components have been added, the entire mixture is mixed for several minutes at higher speeds. The combination does not readily separate as long as the powdered components have a particle size of less than 200 micrometers. When using bigger particles in a combination, RUTF must be mixed quickly by hand right before ingestion to temporarily suspend the larger particles. The mixing process is made easier by using oils that are liquid at room temperature. RUTF can be packed using factory bowls or funnels, by hand (just pouring it), or using a mechanical equipment. The employment of these concepts has resulted in successful RUTF manufacturing in Malawi, Niger, and Congo. Without airtight packing, locally made RUTF has a shelf life of 3 to 4 months. The shelf life of RUTF can be increased to 24 months when packaged in sealed foil envelopes under a nitrogen environment (devoid of oxygen) [9]. Figure 2 shows the main pillars on which a LNS supplement should be evaluated for commercial use while table 2 shows the WHO/UNICEF/WFP/SCN draft specifications for RUTF.



Table 1. Typical composition in 92g of “Plumpy-Nut” LNS widely used around the world [8]

Energy	500 kcal	Vitamin A	840 mcg
Protein	12.5 g	Vitamin D	15 mcg
Lipids	32.86 g	Vitamin E	18.4 mg
Calcium	276 mg	Vitamin C	49 mg
Phosphorus	276 mg	Vitamin B1	0.55 mg
Potassium	1 022 mg	Vitamin B2	1.66 mg
Magnesium	84.6 mg	Vitamin B6	0.55 mg
Zinc	12.9 mg	Vitamin B12	1.7 mcg
Copper	1.6 mg	Vitamin K	19.3 mcg
Iron	10.6 mg	Biotin	60 mcg
Iodine	92 mcg	Folic acid	193 mcg
Selenium	27.6 mcg	Pantothenic acid	2.85 mg
Sodium	< 267 mg	Niacin	4.88 mg

Table 2. WHO/UNICEF/WFP/SCN DRAFT specifications for RUTF [8]

Moisture content	2.5% maximum
Energy	520-550 Kcal/100g
Proteins	10 to 12 % total energy
Lipids	45 to 60 % total energy
Sodium	290 mg/100g maximum
Potassium	1100 to 1400 mg/100g
Calcium	300 to 600 mg/100g
Phosphorus (excluding phytate)	300 to 600 mg/100g
Magnesium	80 to 140 mg/100g
Iron	10 to 14 mg/100g
Zinc	11 to 14 mg/100g
Copper	1.4 to 1.8 mg/100g
Selenium	20 to 40 µg
Iodine	70 to 140 µg/100g
Vitamin A	0.8 to 1.1 mg/100g
Vitamin D	15 to 20 µg/100g
Vitamin E	20 mg/100g minimum
Vitamin K	15 to 30 µg/100g
Vitamin B1	0.5 mg/100g minimum
Vitamin B2	1.6 mg/100g minimum
Vitamin C	50 mg/100g minimum
Vitamin B6	0.6 mg/100g minimum
Vitamin B12	1.6 µg/100g minimum
Folic acid	200 µg/100g minimum
Niacin	5 mg/100g minimum
Pantothenic acid	3 mg/100g minimum
Biotin	60 µg/100g minimum



n-6 fatty acids	3% to 10% of total energy
n-3 fatty acids	0.3 to 2.5% of total energy

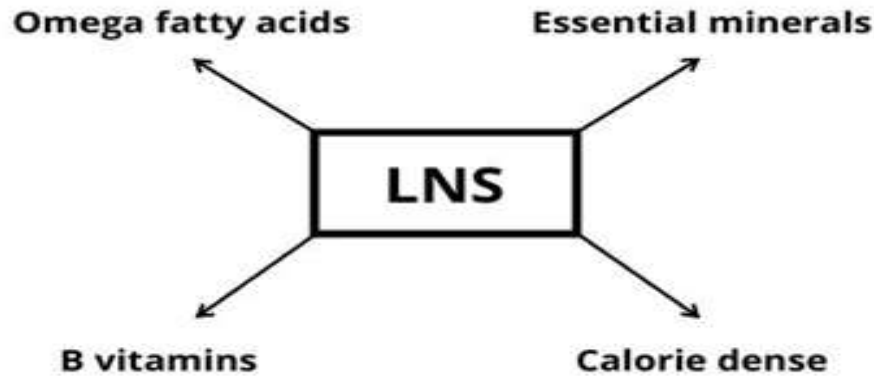


Figure 2. The four main pillars of LNS on which it is evaluated for commercial use

2. Dosage of RUTF / LNS

Since they are supposed to provide all the energy requirements of the child, they are given in large doses (200–300 g/day) [3].

Table 3 shows the dosage parameters of RUTF/LNS “Plumpy-Nut” in children/adolescents.

The normal RUTF dose is determined by the weight of the child being treated [18].

2.1 Types of RUTF’s currently in use

K-Mix 2 - a high energy food, developed by UNICEF in the 1960s [11].

Citadel spread - a paste of peanuts, oil, sugar and milk powder in use since 1971 [11].

Plumpy nut - a solid RUTF, made in France since 1996 for treatment of severe acute malnutrition (SAM) [11].

Medika Mamba - an enriched peanut butter therapeutic food produced and distributed by Meds and Food for Kids in Haiti since 2003 [11].

BP-100 - a nutrient-fortified wheat-and-oat bar designed to provide a similar nutritional profile to F-100 by the World Health Organization [11].

Nutribun - a fortified bread product developed by United States Agency for International Development and distributed under the Food for Peace program [11].

Table 3. Accurate dosing of LNS “plumpy-Nut” based on the weight range of the child/adolescent [8]

Weight (Kg)	Packets / Day	Packets / week
3.5 - 3.9	1.5	11
4.0 - 5.4	2	14
5.5 - 6.9	2.5	18
7.0 - 8.4	3	21
8.5 - 9.4	3.5	25
9.5 - 10.4	4	28
10.5 - 11.9	4.5	32
12.0-13.5	5	35
>13.5	200kcal/kg/day	200kcal/kg/day



2. Evidence of utilization of RUTF's / LNS in different regions of the world

2.1 Vietnam

HaNoi (Vietnam), 27 November 2020 – 10 tons of ready-to-use therapeutic food (RUTF) has arrived in Ha Noi Noi Bai International Airport and will be distributed as part of UNICEF's emergency response to meet the urgent needs of severely malnourished children in the flood and storm-stricken region of central Viet Nam. An estimated 10,000 children under 5 years old in nine affected provinces are suffering from acute malnutrition at this time, and their situation could further deteriorate with health-care services disrupted across the region [12].

2.3 Sahel region

"Specially developed ready-to-use therapeutic foods" and nutrient packs are helping to feed more than one million malnourished children in the Sahel region of Western and Central Africa, according to UNICEF [13].

2.4 Sub-Saharan Africa

Ready-to-use therapeutic foods (RUTF) are energy-dense, micronutrient enhanced pastes used in therapeutic feeding, which have greatly improved the recovery rate of children with severe acute malnutrition (SAM) in sub-Saharan Africa [14].

2.5 Tanzania

Tanzania is one of the countries hardest hit by both HIV/AIDS and child undernutrition. In 2009, HIV prevalence was 5.9% in Tanzania. In the general population, 47.8% of children are stunted, 24.5% are underweight, and more than 4.5% are wasted. To ameliorate such high undernutrition rate, Ministry of Health and other development partners established the RUTF intervention in selected HIV/AIDS Care and Treatment Centers (CTCs) as a pilot intervention in Tanzania [15].

2.6 Ghana

In summer 2015, PPB Ghana began to produce a peanut-based school-feeding supplement called "Vivi" in partnership with the Hershey Co. Since October 2015, about 50,000 school children receive the school supplement daily [16].

2.7 Philippines

February 17, 2022, Tacloban city – Typhoon Odette's victims in Southern Leyte have been receiving ready-to-use therapeutic food (RUTF) to curb acute malnutrition arising from scarcity of nutritious food after the disaster [21].

2.8 Senegal

In Senegal, we found that daily supplementation with 43 g RUTF, a ready-to-use peanut-based therapeutic food,

combined with millet porridge delivered an extra 245 kcal/d of energy and improved body composition, mainly by increasing fat free mass and active cell mass among adults. Outpatient HIV treatment with chronic malnutrition [22].

II. CONCLUSION

It is now known that LNS can prove to be a savior in reducing mortality rates among children by providing adequate supply of vitamins and nutrients. Underdeveloped countries on the verge of food shortage and crashing economy can use this life saving supplement for improving circumstances in case of such situations.

Compliance with Ethics Requirements

Conflict of interest – Author declares that he has no conflict of interest with anyone.

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