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"Peanut-Lacto Catch-Up Bar": A Practical Solution to Fight Kwashiorkor in Ghana with Local Peanuts and Milk Permeate from US Dairy Industry

Imagine a five-year-old girl. In any developed country, you could safely assume that she is staying healthy, starting kindergarten, and growing taller every month. However, this may not be the case in Ghana. Instead, a child of the same age might be short for her age, have swollen legs, and be weak from a nutritionally deficient diet.

This condition has a name, *Kwashiorkor*, and it was first described and named in Ghana by Dr. Cicely Williams. The word comes from the *Ga* language and literally means "the disease of the deposed baby when the next one is born" (Williams). This refers to the older child being abruptly cut off from the valuable nutrients of breastmilk when a new baby is born, and shifted to a low-protein, high-carbohydrate diet (Cleveland Clinic). Medically, kwashiorkor is a type of severe acute malnutrition disease, characterized by severe protein deficiency. It causes fluid retention (edema) and a swollen abdomen. People with kwashiorkor may have food to eat, but not sufficient protein in their diet (Cleveland Clinic).

Background

Ghana, officially the Republic of Ghana, located on the west coast of Africa, has a population of about 36.1 million (United States Census Bureau), with a high concentration of youth. In 2025, around 35% of Ghana's total population was composed of children ages 0–14 (World Bank). Around 58% of its people live in urban areas, and 42% live in rural areas (Statista). Accra is the capital city and serves as the administrative, economic, and educational center of Ghana (Britannica Editors).

Only about 24.4% of land in Ghana is cultivated, allowing for limited crops to be grown for commercial purposes (Agritech West Africa). Farm sizes are relatively small, ranging from 1.56–2.56 hectares (United Nations). Ghana is the world's second-largest producer of cocoa and the fourth-largest producer of cassava. Main crops grown include cassava, tomato, yam, plantain, maize, rice, oil palms, and peanuts (International Trade Administration). Ghana's geography consists of plains and low plateaus. These areas are covered either by rain forests in the west or Lake Volta in the east (National Geographic). The climate follows a tropical, high-temperature pattern, rainy from March–July and September–October (World Travel Guide).

In Ghana, families average around 3.8 individuals (ArcGIS) with diets consisting of yam, cassava, beans, and rice—all grown locally. While these crops form a staple of the Ghanaian diet, most of them are low in protein, iron, and calcium, nutrients which are essential to the body (PMC). Much of this food is grown on family-owned farms and is cooked slowly on charcoal and gas stoves. In 2021, around 39% of people in Ghana made less than $3 per day, making access to protein rich foods inaccessible as they tend to be expensive (The World Bank).

In Ghana, access to healthcare is limited but is gradually improving. About 40% of the population is medically covered through the National Health Insurance Scheme (NHIS) (Aacrao). Pregnant women from poorer households deliver less often in a health facility than those from richer households. Under-five mortality is higher among the poor than the rich (Escribano-Ferrer et al.). Even though Ghana

has advanced infrastructure compared to some other low-income African countries, the quality of life remains low, especially in water reliability and cleanliness (World Bank).

Food insecurity is defined as the condition of not having access to sufficient food that meets the basic human needs. In Ghana, it is estimated that approximately 2.02 million people are food insecure and 1 million children under the age of five are chronically malnourished (World Food Programme). This food insecurity is caused by poverty and production losses due to climate, economic conditions, and seasonal patterns.

Challenge and Impact

One of the main types of protein deficiency disease, Kwashiorkor, can affect people of any age, but in Ghana, it is most common in children ages 3–5. This is partially due to the transition of the child from breastfeeding to nutritionally insufficient diets that are high in carbohydrates and low in protein, iron, and calcium, causing inadequate food replacement. Symptoms of kwashiorkor include dehydration, stunted growth, and a bloated stomach. This disease is mostly seen in developing countries facing poverty and food scarcity (Cleveland Clinic).

Treating kwashiorkor can be difficult. Strict refeeding protocols must be followed, or else life-threatening complications can arise. A cautious and gradual refeeding regimen is vital as undernourished bodies have an altered metabolism, and refeeding can change the metabolism. If this process happens too rapidly, refeeding syndrome may occur. Refeeding syndrome is a potentially fatal condition that could cause heart failure and swallowing issues due to electrolyte imbalances and deficiencies for long periods of time (Cleveland Clinic).

Recommendation

Considering the wide availability and excess supply of milk permeate in the US, I recommend a peanut and milk permeate-based, tasty and nutritious snack bar that will directly target the main issue of malnutrition in Ghana. In this snack, peanuts will provide protein from plants, while milk permeate will provide energy from lactose; additionally, its electrolytes will provide micronutrients and hydration due to its high BHI levels.

I propose a novel snack bar, the “Peanut-Lacto Catch-Up Bar.” This bar will be similar in appearance to energy bars widely available in many countries. It will comprise of core macronutrients: proteins, carbohydrates, and fats, as well as electrolytes and other micronutrients valuable for the growth and development of children suffering from kwashiorkor in Ghana. The idea is not to replace local foods, but to complement them. Cassava, yam, maize, and plantains may remain the core of meals, but these foods are rich in carbohydrates and poor in protein. Governmental and humanitarian organizations can integrate the proposed bar into school meals to raise protein and electrolyte intake, preventing kwashiorkor. Many schools in Ghana already use Ready-to-Use school meals, which are a safe and viable alternative to traditional feeding (Shani et al.).

The US is among the largest producers of milk in the world, with India as the top competitor (USDA). Milk and milk products have been a staple part of the diet in the US for many decades. People in the US particularly enjoy fluid milk to drink and to use in their cooking. Cheese, ice cream, and butter are other common dairy products. Globally, high-protein dairy beverages (including protein powders for ready-to-mix applications) are on the rise, with an average annual new product launch rate of 20.8% from 2016 to 2022 (Singh et al.). Regular cow milk contains approximately 3.2% fat, 3.27% protein, and 4.81% lactose. Milk also contains minerals including calcium (123 mg/100 g), magnesium (11.9 mg/100 g), phosphorus (101 mg/100 g), sodium (38 mg/100 g), zinc (0.42 mg/100 g), iodine (37.9 µg/100 g), and

selenium (1.9 µg/100 g) (USDA FoodData Central). High-protein milk products are produced utilizing a raw material called ultrafiltered milk (UF milk). While no standards are defined under FDA's 21 Code of Federal Regulations (CFR) for UF milk, this product, in general, has about 14% protein and less than 1% lactose (carbohydrate).

Membrane separation is a physical method of separating milk components based on their size and molecular weight. Membrane processing offers distinct advantages in the dairy industry, including reduced energy consumption, greater processing capacity, and improved production. Ultrafiltration is a widely used membrane filtration method in the dairy and beverage sector, enabling the selective retention and passage of certain components through a semi-permeable membrane. This membrane typically has pore sizes ranging from 0.01 to 0.1 µm, which selectively allow smaller particles, such as water, lactose, soluble minerals, non-protein nitrogen (NPN), and water-soluble vitamins, to pass through as permeate while trapping or retaining larger molecules (such as proteins), resulting in a concentrated stream called "retentate" (Don et al.).

Ultrafiltration separates milk components according to molecular size. During this process, milk passes across a semi-permeable membrane under high pressure. Most of the lactose, soluble minerals, and water will cross through ("permeate") the membranes and become the permeate stream. Larger molecules, such as milk proteins (Casein and whey proteins), do not pass through this membrane (hence, are "retained") and become part of the retentate stream. It is this retentate stream that becomes the UF milk. UF milk is currently sold as a fluid ingredient that supplies higher protein and lower lactose levels compared to condensed milk. UF milk can be dried to produce a "Milk Protein Concentrate" (MPC) powder (Dairy Management Inc.). Therefore, the UF process facilitates the separation of components based on molecular size, making it ideal for applications requiring higher protein content and reduced lactose, such as cheese, high-protein yogurts, and milk protein concentrate (MPC) (Don et al.) (Membrane Systems Specialists, Inc.)

The increasing production of whey protein products worldwide means there is also an increase in the production of byproducts from these processes, such as whey permeates, which are a lactose-rich product. Currently, the main applications of this waste stream are the production of edible or pharmaceutical grade lactose, or spray-dried permeate powders. A significant amount of permeate is still disposed of as waste or used in animal feed. In the US, it is estimated that only 20% of permeate produced is used in food applications, with the remaining used in animal feed (O'Donoghue and Murphy). Currently, there is an excess supply of milk permeate in the US. Due to this excess, milk permeate is often discarded or used as animal feed. In 2023, 550,000 tonnes of permeate was dried in the US and 85% was used as animal feed, mainly in China (McDonald). In contrast, milk production in Ghana is relatively low and meets only about 19% of the demand (Atongbiik Achaglinkame et al.).

Milk permeate is a liquid that remains after the UF process. This liquid is protein and fat-free, containing about the same carbohydrate and mineral content of milk. Milk permeate also has a high concentration of sodium and potassium. Along with that, milk permeate has hydration characteristics. The Beverage Hydration Index (BHI) compares the hydration efficacy of beverages to water. The BHI of milk permeate is significantly higher than water and traditional carbohydrate-based electrolyte solutions (Berry et al.).

To combat the kwashiorkor issue in Ghana, milk permeate from the US can be presented to Ghana using various options—for example, it can be sold, relief agencies such as the United Nations or Red Cross can buy it at discounted prices, or it can be donated to be used for producing a nutrient-dense food that will help undernourished children. This will allow Ghanaian children to receive the vital nutrients they need.

Peanuts (*Arachis hypogaea* L.) are an oilseed crop that also satisfies the protein needs of many who cannot afford animal protein (Market Developmental Program for Northern Ghana, UKaid). Known as

nkatie in the language *Akan*, peanuts are already grown across Ghana and West Africa. In Ghana, peanuts are referred to as groundnuts. Peanuts are a major cash crop for people in Ghana, especially in the north. The cultivation of peanuts is a major agricultural activity for people who live in Northern Ghana. Men and even women are oriented towards cash crops, growing peanuts and vegetables. Around 90% of farm families cultivate peanuts. Peanuts are common in the diet of an average Ghanaian (Jolly et al.). They are used in many dishes, as well as snacks. Roasted peanut is a common snack eaten with bananas, while peanut butter is used for soup and bread spread (Tsigbey et al.). Ghanaians also consume peanuts in the form of raw and cooked shelled nuts, roasted shelled nuts, roasted and coated shelled nuts, paste, and other groundnut blends. However, the most common use of peanuts is groundnut soup, with between 39% to 60% of the population consuming the meal (Jolly et al.). Peanuts are mostly consumed in the paste form as an important soup ingredient. In addition to the paste, peanuts can be consumed as whole roasted peanuts, whole boiled unshelled peanuts, and peanut butter/spread (Taylor). Per capita annual consumption of groundnuts in Ghana is higher than the US, at 12 kg compared to the US at 3 kg (Market Developmental Program for Northern Ghana, UKaid).

One cup of peanuts provides around 38 grams of protein, along with fats, calcium, iron, and magnesium. They are a cost-effective, plant-based protein source that fits local production methods (University of Rochester Medical Center).

While the formulation of this bar helps meet nutritional requirements, its success in reducing kwashiorkor will rely on solving certain operational challenges: supply chain logistics, control of food formulation, cultural acceptance, and program sustainability. Spray-dried milk permeate can be imported from the US to Ghana's food processing facilities using a supply chain designed for transporting dry goods. This will prevent spoilage of the product during transit. Tight control on the recipe of the "Peanut-Lacto Catch-Up Bar" will ensure a uniform product. Cultural acceptance of this novel food product will be enhanced by highlighting the nutty, caramel-like flavor profile, which is similar to roasted peanut paste. Awareness sessions can be conducted to make people familiar with the taste of this product. For long term sustainability of this product, food donations and imports should be complemented by developing local manufacturing partnerships, helping keep production costs low. Using local labor and production facilities will provide employment opportunities in addition to meeting the nutritional requirements of the Ghanaian population.

Conclusion

By combining Ghana's locally grown peanuts with abundant US milk permeate, the "Peanut-Lacto Catch-Up Bar" offers a practical, low-cost way to fight kwashiorkor. This nutritious bar will strengthen diets that are often high in carbohydrates and low in essential proteins and minerals. With its blend of peanut protein, milk-derived carbohydrates, and electrolytes, it can support healthier growth for children who need it most. When schools and communities adopt solutions like this, every child gains a fair chance to learn, grow, and thrive. Simple ingredients, used wisely, can help Ghana take a major step toward ending kwashiorkor.

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