“Children with moderate malnutrition should get the foods that provide all the nutrients they need for full recovery, not just the food choice that represents the cheapest option to provide them energy and proteins. Their efficacy to promote recovery and their accessibility must be the first criteria to consider when making a choice” - World Health Organization
Executive Summary

From the ground up, peanuts are natural foods that inherently possess numerous nutritional components combined into a small package. Peanuts have been recognized through the ages for various benefits, many of which surround health. Peanuts are full of healthful macronutrients in addition to micronutrients that are of concern to many populations. Over the past decades, growing interest in the area of functional foods has led to the discovery of numerous beneficial compounds in peanuts that have been called by various terms, which include functional compounds, bioactive components, and phytochemicals.

The unique, complex characteristics of peanuts place them in a distinctive category as they have been shown in population and human research studies to lower the risk of chronic disease, help manage weight, and improve nutrient adequacy. Evidence has shown that peanuts benefit a variety of populations and age groups. The improved success rates in malnourished children using peanut-based food aid and the improved nutrient and weight status in malnourished obese who consume peanuts indicate that there is something more to this natural food than was once realized.

Peanuts provide condensed energy in a small amount, healthy plant protein, and nutrients critical to development that are key factors for those with compromised nutrition. The components in peanuts are easily digested, contributing to their acceptability as a commonly consumed food as well as the fact that they are well liked with an enjoyable flavor. Peanuts and peanut butter complement many foods, including staple grains used in humanitarian relief and can be added to diets dependent on such foods to enhance overall nutritional quality.

This white paper provides an overview as to why peanuts are a natural health food for all. It highlights the unique characteristics of peanuts and peanut butter, the research on their health benefits, and shows how they can be useful when added to diets the diets of young and old as well as undernourished and over-nourished populations around the globe.

Patterns of Peanut History and Consumption

The domestication of peanuts dates back thousands of years to South America, where peanuts were recognized in decorative art and were furnished at gravesites as food for the afterlife. Explorers brought peanuts to Europe and then to Africa and they soon became recognized as affordable, nutritious food for slaves being transported. They eventually traveled worldwide, making their way to China and to the United States (US). Over time in the US, peanuts became a crop in high demand to be consumed as a nut, for their oil, or for their use as peanut butter or in various products. In the late 1800s physicians recommended the use of peanut butter as a nutritious digestible protein source for people with poor teeth.

For centuries through today, peanuts have been enjoyed in many culinary applications from Chinese to African to Western cooking. Used in stews, sauces, porridge, mixed dishes, boiled, or eaten out of hand; peanuts have continually nourished different populations providing an enjoyable flavor. Millions of peanuts are grown and consumed around the world. China, India, the US, and parts of Africa grow the most peanuts. In the US, peanuts and peanut butter comprise over two-thirds of all nut consumption and they are considered an all-American favorite.

Peanuts are a Protective Package of Nutrients

Peanuts: Full of Healthy Fat, Protein, and Fiber

Peanuts are a plant food. They are high in fat, but the majority of this fat is known to be heart-healthy monounsaturated fat, like that found in olive oil. “Bad” fat -- saturated, found in many animal products, is low in peanuts, and trans fat,
found in many processed foods is not found in peanuts. Unlike animal protein, which oftentimes contributes bad fat to the diet, peanuts provide protein that carries with it additional components that have positive health benefits. The total amount of carbohydrate in peanuts is low with over half consisting of healthy fiber.

**Peanuts Add Hard-to-get Vitamins and Minerals to the Diet**

Peanuts naturally provide nutrients that are hard-to-get for many populations in as little as one serving. Looking at the diets of more than 15,000 children and adults in the US showed that those who consumed peanuts and peanut products achieved higher Recommended Daily Allowances (RDAs) for many important hard-to-get nutrients than those who did not eat peanuts. They had higher quality diets and levels of vitamin A, vitamin E, folate, magnesium, zinc, iron, calcium, and dietary fiber. While peanuts do not contain calcium, over two-thirds of the peanut butter eaten is consumed with milk.

Data from the 2001-2004 “What We Eat in America,” National Health and Nutrition Examination Survey (NHANES), which looked at those two years and older also showed that peanut and peanut butter eaters take in more critical nutrients. Levels of vitamin E, niacin, food folate, magnesium, copper, and potassium were significantly higher than in non-peanut eaters contributing to much of the days needed intake for these nutrients.

Additionally, a human study conducted at Purdue University showed that eating about three ounces of peanuts daily significantly increased intake of fiber, magnesium, folate, vitamin E, copper, and the amino acid arginine. When blood levels of magnesium were measured, baseline values fell below recommended

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Function in Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>Folate</td>
<td>Helps produce and maintain cells; especially important in infancy and pregnancy</td>
</tr>
<tr>
<td>Niacin</td>
<td>Assists in the functioning of the digestive system, skin, and nerves; conversion of food to energy</td>
</tr>
<tr>
<td>Pantothenic acid</td>
<td>Critical in the metabolism and synthesis of carbohydrates, proteins, and fats</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Maintains normal muscle and nerve function, keeps heart rhythm steady, supports a healthy immune system, keeps bones strong, helps regulate blood sugar levels, promotes normal blood pressure</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Primary function is in the formation of bones and teeth; synthesis of protein for the growth, maintenance, and repair of cells and tissues</td>
</tr>
<tr>
<td>Potassium</td>
<td>Necessary for the building of muscle and for normal body growth.</td>
</tr>
<tr>
<td>Zinc</td>
<td>Immune support; building of proteins; wound healing; supports normal growth and development during pregnancy, childhood, and adolescence</td>
</tr>
<tr>
<td>Thiamin (B1)</td>
<td>Helps the body cells convert carbohydrates into energy; essential for the functioning of the heart, muscles, and nervous system.</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Antioxidant; helps convert food to energy; immune function; regulation of other metabolic processes</td>
</tr>
<tr>
<td>Choline</td>
<td>Critical for normal membrane structure and function; important to lung function and memory development in infants</td>
</tr>
<tr>
<td>Iron</td>
<td>Integral part of many proteins and enzymes that maintain good health; involved in oxygen transport and regulation of cell growth and differentiation</td>
</tr>
<tr>
<td>Copper</td>
<td>Plays a role in the production of hemoglobin, myelin, collagen, and melanin</td>
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<tr>
<td>Manganese</td>
<td>A cofactor for enzymes</td>
</tr>
<tr>
<td>Selenium</td>
<td>Provides antioxidant function, helping to prevent cellular damage from free radicals; regulates thyroid function and plays a role in the immune system</td>
</tr>
<tr>
<td>Riboflavin (B2)</td>
<td>Key role in energy metabolism, and is required for the metabolism of fats, ketone bodies, carbohydrates, and proteins</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>Involved in protein and red blood cell metabolism; role in nervous and immune systems</td>
</tr>
<tr>
<td>Arginine</td>
<td>Improves healing time in tissues; Precursor for the synthesis of nitric oxide, which expands blood vessels and can help decrease blood pressure</td>
</tr>
<tr>
<td>Fiber</td>
<td>Adds bulk to diet providing feelings of fullness; lowers total and LDL cholesterol reducing the risk of heart disease; slows absorption of carbohydrate, helping to regulate blood sugar; facilitates digestive regularity; stimulates intestinal fermentation, which may reduce the risk of colorectal cancer</td>
</tr>
</tbody>
</table>
levels, but increased in all of the peanut eaters to above recommended levels corresponding with a range required to lower cardiovascular disease (CVD) risk.

Peanuts and peanut butter have been recognized as a great way to get multiple nutrients in a small portion from a single food source. Data show that obtaining certain nutrients from foods versus supplements can be beneficial. Studies on vitamin E supplementation, for example, show mixed benefits on health outcomes, but research does not suggest adverse effects from consuming naturally occurring vitamin E in foods. Peanuts studied in the US were recently shown to provide significantly higher levels of natural vitamin E than was previously reported. Table 1 highlights some of the nutrients found in peanuts and peanut butter and their beneficial functions in regards to health.

**Peanuts Bring Unique Health Promoting Functional Components**

Research has identified numerous compounds in peanuts and in their skins that may have added health benefits beyond basic nutrition. For example, arginine is a bioactive compound found in peanuts. It is an amino acid that is a precursor to nitric oxide, which helps to keep arteries relaxed, improving blood flow. Aside from the macro- and micronutrients, the functional compounds in peanuts can be clustered into four main categories: 1) flavonoids, 2) phenolic acids, 3) phytosterols, and 4) stilbenes. The compounds that fall under these categories function in various ways to promote health and some have antioxidant capacity. Resveratrol, for example, is a stilbene known for its role in various mechanisms that reduce cardiovascular disease (CVD) and cancer risk. It is said to have life promoting capabilities and to increase endurance. Table 2 highlights each category, summarizes their health benefit, and provides examples of each compound.

**Peanuts Nourish Many: From Malnutrition to Obesity**

When eaten in small amounts, peanuts can aid in providing critical nutrients to all ages and all populations. Malnutrition, specifically severe acute malnutrition in children, is a serious problem that is preventable. Yet it contributes to over 4 million deaths a year, more than deaths due to HIV/AIDS, Tuberculosis, and Malaria. Children deprived of essential nutrients because of malnutrition oftentimes experience stunted growth, developmental delays, and wasting. In addition, they have increased risk of chronic disease and lower life expectancies. Emerging research is beginning to show that including key nutrients in the diet in utero and in infancy not only improves acute nutrient status and survival rates, but also can impact long-term health and reduce the risk of multiple age-related diseases. Peanuts provide many vitamins and minerals important in critical times of development. For example, data show that choline status early in life may have an impact on long-term memory, while zinc status clearly affects growth rates.

On the other end of the spectrum, there is currently a growing population of malnourished obese individuals with increased risk of chronic disease who take in too many calories, yet too few nutrients. Data show that despite excess energy intakes, overweight children, for example, are not meeting the dietary reference intakes or recommended daily allowance of many nutrients, specifically vitamins and minerals. Peanuts are recognized as a nutrient-rich preventative food for these individuals and research supports their daily use to promote health, manage weight, and improve nutrient adequacy.

**Peanut Research Shows Long-term Health Benefits**

**Peanuts and Chronic Disease**

Large population studies show that diets rich in peanuts and peanut butter decrease the risk of chronic diseases like heart disease and diabetes that plague the United States. Small daily portions of peanuts, 1 to 1 ½ ounces
have been shown to cut the risk of heart disease in half and the risk of developing type 2 diabetes by a quarter.\textsuperscript{18,19} The best results have been in people who eat peanuts five or more times per week. A recent meta-analysis also provides strong evidence supporting an association between monounsaturated fat as well as overall nut intake and reduction in the risk of coronary heart disease.\textsuperscript{20}

The good fat in peanuts lowers total and bad LDL cholesterol and triglycerides, while keeping good cholesterol high.\textsuperscript{21} Frequent peanut consumption (>five times/week) is also associated with lower levels of certain inflammatory markers that are predictors of cardiovascular disease (CVD) and type 2 diabetes.\textsuperscript{22} Blood pressure also improves in people who consume peanuts and peanut butter as part of a high plant protein diet.\textsuperscript{23} Moreover, a large population study showed a reduced risk of colorectal cancer in women who consumed peanuts two or more times a week.\textsuperscript{24}

Minerals such as magnesium found in high levels in peanuts have been identified as key players associated with reduced incidence of inflammation, metabolic syndrome, CVD, and type 2 diabetes, especially in children.\textsuperscript{25-28} Vitamin E has been shown in population studies to be important to heart health.\textsuperscript{29}

The array of bioactive components that are found in peanuts noted in Table 2 are likely also contributing to these benefits. The phytosterol, beta-sitosterol, for example, has been shown to protect against heart disease as well as to offer protection from colon, prostate, and breast cancer.\textsuperscript{30-34} Cancer growth and spreading to other parts of the body was inhibited by as much as 50 percent in one study.\textsuperscript{31}

**Peanuts and Weight Management**

Peanuts work on both ends of the spectrum as they have been shown in peanut-based food aid to help malnourished infants achieve weight gain success, while research shows that adults and children who consume peanuts have more successful weight loss and maintenance.\textsuperscript{35-37} Peanuts help keep weight in check because they are nutritionally balanced with great satiating qualities.

Peanuts and peanut butter have been shown to provide eating satisfaction because they provide a feeling of fullness significantly longer than high carbohydrate foods.\textsuperscript{38} The protein and fiber found in peanuts are thought to contribute to this, as well as the fact that peanuts can keep blood sugar stable. Emerging evidence also shows that the type of monounsaturated fat found in peanuts may stimulate a hormone linked to satiety.\textsuperscript{39} Peanuts can help reduce cravings and provide lasting energy until the next meal.

The enjoyable flavor of peanuts adds to eating satisfaction and acceptability as well.

In a moderate fat diet that included peanuts and peanut butter versus a low-fat diet, peanut-eaters were more likely to continue with the diet.\textsuperscript{35} People felt less deprived as the fat in peanuts helped to provide flavor and enjoyment with eating.

Peanuts are steadily absorbed into the body so that blood sugar and insulin levels do not become high.\textsuperscript{40} Their balanced macronutrients contribute to this, but when eaten with high glycemic index foods, they also attenuate blood sugar levels, indicating that the bioactive components in peanuts may also play a role.\textsuperscript{41}

**Peanuts Provide Key Nutrition for Survival**

Proper nutrition is not only critical to health and development, but also to survival in those who are malnourished. In utero and in infancy, adequate nutrient intake can make or break the health status of an individual. Better nutrition equates to improved mental and physical development, stronger immune systems, less illness, and improved short and long-term health, which lead to reduced rates of mortality. Peanuts possess key nutritional attributes that can improve health status and help promote recovery in those who are malnourished or who have compromised nutritional status.
Healthy Fats

Peanuts provide a lot of energy in a small amount, which is important to the malnourished who can only consume small amounts at one time. Providing enough calories is critical so that protein can be spared for growth and repair. Peanuts are about 50 percent fat, which at 9 calories per gram, contribute more calories than traditional foods used in humanitarian relief such as milk, corn, soybean, wheat, and other grains.

Fat requirements are highest in infancy. All fatty acids are essential for growth, especially for the development of the nervous system and of the brain, which is 60 percent fat. Fat is also a key requirement in the absorption of fat-soluble nutrients including vitamins A, E, D, K, and carotenoids.

The majority of fat in peanuts is heart-healthy monounsaturated fat, with balanced levels of polyunsaturated and saturated fats. Figure 1 shows the fat profile of peanuts. A study in adults, published in the December 1999 issue of the American Journal of Clinical Nutrition, found that diets high in monounsaturated fat from foods like peanuts, peanut butter, peanut oil, and olive oil are superior to low-fat diets for heart health.

Emerging data clearly shows that type of fat can impact health in various ways at different stages of life. The fat in peanuts and peanut provides healthy calories to malnourished infants and children at their time of need.

Rich in Protein

Protein has many important functions in the body and is essential for maintenance and repair of tissue, particularly during the rapid growth period of infancy and early childhood. It enhances the immune system and promotes muscle development. With starvation, body proteins in tissue and muscle are broken down into amino acids that are used to produce compounds that sustain life.

Peanuts and peanut butter provide higher levels of healthy plant protein when compared to grains and most other legumes, which also contribute healthy calories and nutrients upon consumption. Figure 2 shows the amount of total protein in various legumes and grains. Compared to cornmeal, for example, which has 5 grams of protein per half cup, peanuts have 19 grams per half cup. Consuming the same amount of protein can be achieved by eating fewer peanuts compared to the amount of other grains. Over three and a half times the amount of cornmeal or rice would have to be consumed to obtain a total days protein needs.

A healthy balance of protein that includes plant sources has been shown to benefit chronic disease risk. The inclusion of plant protein such as from peanuts or peanut butter brings an enhanced variety of protective nutrients into the diet that would not otherwise be present. These additional factors could also contribute to possible improvements in malnutrition success rates and school-aged child nutrient adequacy.

Digestible

The components in peanuts are highly digestible. The true protein digestibility of peanuts is comparable with that of animal protein, but since plant proteins are usually low in one of the essential amino acids (called the limiting amino acid), their digestibility is less than that of animal products. The limiting amino acid in peanuts varies based on the study (i.e. lysine, methionine, threonine). Wheat and rice share lysine as a limiting amino acid.

Protein quality is defined based on the amino acid pattern and percent of digestibility of protein.
A score for protein digestibility termed “protein digestibility corrected amino acid score” or “PDCAAS” is determined by comparing essential amino acid requirements based on age to the essential amino acids that are still available to the body after food digestion. It reflects the amino acid content in comparison with an ideal protein.

Protein requirements are based on consuming foods with a PDCAAS of 1.0, which is the highest score. The PDCAAS for peanuts has been estimated to be about 0.70. Table 3 shows percent digestibility and the average calculated PDCAAS for peanuts and other selected grains.

Fat digestibility varies based on the structure of different fatty acids. Saturated fats are full of hydrogen and have single bonds which make them more difficult to break down, whereas unsaturated fats have at least one location where hydrogen can be added (double bond), thus making them easily digested and usable by the body. Peanuts are over 50 percent monounsaturated fats, which are easily digested.

Sometimes, inherent factors in foods can cause a decrease the effectiveness of certain nutrients from the food itself. Such compounds include protease inhibitors, phytic acid, or fibers that could affect bioavailability of nutrients or result in impaired growth and poor food utilization. Because peanuts are legumes, they contain some phytic acid, but the amount in peanuts can be lower than in other legumes such as soybean. The fiber in peanuts is mainly insoluble, with lower amounts of soluble fiber. It contributes to daily intake, but has not been shown to bind nutrients and restrict their absorption. In fact, the small amount of soluble fermentable fiber may improve absorption of some minerals.

**Nutrient Dense**

It is more than just healthy calories, fat, and protein that make peanuts and peanut butter stand out as unique healthful foods. As noted in Tables 1 and 2, they are rich in multiple natural micronutrients as well, including vitamins, minerals, and bioactive compounds such as resveratrol that are beneficial to health, making them a viable option for improving the nutrition status of those who are malnourished, developing, growing, or in need of critical nutrients.

Many of the nutrients in peanuts are integral to growth, development, metabolism, and immunity. It is likely that the individual nutrients in peanuts work by multiple mechanisms and that they have synergistic effects toward improving health status.

### Success Rates Greatly Improve with Peanut-based Ready-to-Use Therapeutic Food

**Background**

While the calories provided by food aid are lifesaving, there is now a push to better tailor food aid to the needs of young children with high-value protein and adequate micronutrients. The development of Ready-to-Use Therapeutic Food (RUTF) for use in famine relief has radically changed the approach to treating severe acute malnutrition, meeting many of the treatment needs. RUTF is also called Plumpy’nut because it is a lipid-based mix containing ground, roasted peanuts. In addition, vegetable oil, powdered milk, vitamins, minerals, and sugar are added. Peanuts as the basis for RUTF enable better delivery of a full range of balanced lipids, essential amino-acids, minerals, and vitamins required by developing children. Peanuts are calorie and nutrient-dense, and protein-rich, ideal for small stomachs in malnourished children who can only take in small amounts. Their high lipid content also helps protect vitamins against oxidation.

**Figure 3. Weight Gain in Children Consuming RUTF Versus Maize/Soy Flour Therapy**

<table>
<thead>
<tr>
<th>Food Item</th>
<th>True Digestibility%</th>
<th>PDCAAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peanuts</td>
<td>94</td>
<td>0.70</td>
</tr>
<tr>
<td>Soy</td>
<td>86</td>
<td>0.91</td>
</tr>
<tr>
<td>Whole Wheat</td>
<td>86</td>
<td>0.46</td>
</tr>
<tr>
<td>Maize</td>
<td>85</td>
<td>0.43</td>
</tr>
</tbody>
</table>

Table 3. Percent Digestibility and PDCAAS Values for Peanuts and Selected Grains
Research Studies

Multiple clinical trials have been successfully conducted with peanut-based RUTF since its production. The populations in need of rehabilitation have included moderately or severely malnourished children, children with edema, and children infected with HIV. Results corroborate the fact that peanut-containing RUTF is effective in producing healthy, rapid weight gain. Figure 3 shows weight gain comparing RUTF and a maize/soy flour therapy in malnourished children over one year of age in a study in Malawi.55

Treatment with RUTF in children has repeatedly shown superior recovery rates and shorter duration to reach weight-to-growth goals compared to standard World Health Organization (WHO) therapies for malnutrition rehabilitation.55-60 Success with RUTF has also been proven as home-based therapy that does not require medical staff.55,57,61,62 Figure 4 shows published recovery rates of peanut-based RUTF versus other standard therapies.

In 2003, Diop, et al. showed that energy and protein consumption was increased, and more weight was gained in severely malnourished children who consumed RUTF versus a standard therapy.63 Rehabilitation time also occurred faster in those on peanut-based RUTF. Another study in 2004 showed that moderately malnourished RUTF-users had higher intake of energy, fat, iron, and zinc compared to a group consuming corn/soy therapy because the consumption of staple foods fell in the corn/soy group.61 Both therapies resulted in modest weight gain, but the effect lasted longer for the RUTF group.

The evidence is striking. Peanut-based RUTF is improving the quality of humanitarian relief and is saving more lives than ever before. Its use has shown success in a number of populations and countries, including Sudan, Haiti, and many in Africa. Evidence also shows that compared to other treatments, peanut-based RUTF used as complementary food provides additional micronutrients and energy from healthy fat and can have a sustained impact on the incidence of severe stunting in children.64-66
Although success rates improve partially due reasons such as reduced bacterial contamination problems because of the elimination of the use of water, there is likely something more to the peanut in this formulation. Peanuts and peanut butter are natural whole foods well-recognized for their health properties even in nourished individuals who are considered healthy.

**Peanuts: Instrumental to Health in a Variety of Ways**

**Acceptable**

Peanuts have been a familiar favorite in the United States and their acceptability has proven to span different ages and cross cultural barriers. Human studies that feed peanuts daily have shown that they have a high acceptability rating. Peanuts and peanut butter fed daily to Mexican-American adolescents in place of nutrient-poor snacks not only improved quality of calories, but were well accepted by the significant majority of children.

Critical to the success of peanut-based RUTF is the fact that infants and growing children like the taste of it so that all nutrition needs are met with multiple feedings. Since peanuts and peanut butter are well liked and full of nutrition, they can be instrumental in improving the health status of individuals, especially in children by continued use in RUTF or in US and international school feeding programs.

**Familiar, Versatile, Complementary**

Peanuts are an American comfort food, but are an indigenous food to certain countries dealing with malnutrition or reduced nutrient intake. Thus, they are a familiar food to many, but may not be fully utilized. In addition to eating peanuts by themselves or as peanut butter, they can be enjoyed in various ways to further enhance nutrition by complementing commonly consumed staple foods such as grains like corn and wheat, which are also often provided in food aid.

Combining peanuts or peanut butter with corn, wheat, or certain other grains with different limiting amino acids can produce higher-quality protein and boost the levels that are consumed. Additionally, including peanuts with milk or soy can further increase the natural source of micronutrients such as magnesium, niacin, pantothenic acid, vitamin E, and choline, which are important to development and rehabilitation. The addition of peanuts could also slow down the absorption of carbohydrates, promoting satiation, and acceptability.

**Summary and Conclusions**

Peanuts are unique with a myriad of protective nutrients packaged into small, tasty kernels. Research on peanuts and peanut butter clearly shows that when eaten in small amounts daily they improve the risk of multiple age-related diseases. They are eaten in a variety of ways and are enjoyable, satisfying, and acceptable to those in need of nutrition as well as to over-nourished who need to manage weight. Peanuts have been recognized for centuries as a nutritious food and research is now uncovering some of the specific functional compounds in peanuts that likely contribute to their health benefits. Cracking open a peanut pod has allowed us to begin to take advantage of the natural health benefits that peanuts bring to each one of us across the globe.
References


