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FINAL REPORT FOR WORK
DONE UNDER RESEARCH AGREEMENT

Final Report

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INSTITUTION: UGA Research Foundation

PROJECT TITLE: Development of a Drinkable, Peanut Based Dietary Supp. & Comparison of its Nutritional & Microbiological Qualities with Commercial Products

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FINAL REPORT:

Introduction

Much of the dietary/nutritional supplement and related nutritional products are targeted at aging populations whose major health concerns include diabetes and cardiovascular disease. Most liquid *dietary supplement* products (for example Ensure®, Glucerna , and Boost) are made from 'traditional' ingredients such as milk proteins, vegetable oils, soybean protein concentrates/isolates, supplemented with vitamins and minerals. Peanut ingredients have not achieved penetration into this market segment, despite the known desirable nutritional content of peanuts and the positive physiological impacts arising from peanut consumption (1). These attributes include enhancement of satiety, making it easier to achieve and maintain weight loss and a healthy fatty acid profile. It has also been well documented that diets containing plant-derived proteins produce lowered serum cholesterol in humans and experimental animals compared to animal protein-based diets (2). The relatively high content of the amino acid arginine or a high arginine-to-lysine ratio in plant proteins is thought to be one reason (3). Peanut protein has one of the highest arginine contents of any protein and since it is relatively low in lysine, its arginine/lysine ratio is one of the highest known. The arginine/lysine ratio for peanut is 3.34, while for soy it is 1.18, for beef, 0.76; and for egg is 0.84. The role of L-arginine in health arises from its complex and multifaceted role in metabolism. A major role of arginine is as precursor to nitric oxide which acts as a potent vasodilator, maintaining healthy blood pressure and also preventing atherosclerosis, in part by preventing platelet clumping (4). The poor endothelial function in hypercholesterolemic animals and humans is reversed by intravenous infusions of L-arginine. Arginine supplementation also has been shown to ameliorate a number of experimental kidney diseases (5). In addition, peanut protein produces Angiotensin Converting Enzyme inhibitory peptides during digestion (6). These have the potential to reduce blood pressure in the same manner as Enalapril® and other drugs. Contrary to the effects of arginine, the amino acid methionine is implicated in the occurrence of atherosclerosis. Excessive dietary

methionine may induce the condition by increasing plasma lipids or contributing to endothelial cell injury, the same things that arginine prevents. Methionine is also the precursor of homocysteine which induces oxidative injury stress and injury to endothelial cells (7). Peanut protein contains 1.22 g methionine/100g protein while soy, beef and egg contain respectively 1.24, 3.71 and 3.06. Additionally, the extremely high folate content of peanuts is significant in ameliorating high plasma homocysteine levels. Thus, it seems possible that the high level of indispensable amino acids such as lysine and methionine that makes animal proteins desirable for meeting the nutritional needs of rapidly growing infants and children may make them less desirable for adults. Plant proteins may, in fact, be much healthier in the diets of adults who have far lower requirements for indispensable amino acids than do children. Peanut has also been shown to have a low glycemic index itself, and help regulate blood glucose as part of an otherwise high glycemic load meal. Commercialization of a nutritional supplement based on peanut would open an entirely new market for the crop via the production of high quality peanut ingredients.

Methodology

Formulation

The Creative Formulation Concepts, CFC4-S2® software was used to formulate a mix that would be processed to develop the beverage with the anticipated nutrient requirements. This computer program uses the composition of a list of ingredients to produce blends meeting imposed dietary requirements. After considering a range of ingredients and development of a number of tentative formulations, the following ingredients and their nutritional composition were input into the program:

Peanut flour (28% fat), Peanut flour (12% fat)
Brown rice flour
Flaxseed meal
Sesame flour

The peanut flours were donated by the Golden Peanut Company and the rest of the ingredients (Bob's Red Mill brand) were purchased from Kroger. Brown rice flour was chosen as a carbohydrate source because it has a fair amount of protein and fiber compared to white rice flour. Sesame flour and flaxseed meal were selected because both have a very high arginine content of 6.67g/100g and 1.54g/100g respectively, and flaxseed has a rich content of alpha-linolenic acid and lignan which are food components that are of functional benefit to the body. The nutrient profiles of peanut flours were obtained from the USDA nutrient profile and adjusted with that provided by the manufacturer. The profiles of the brown rice flour, flaxseed meal and sesame seed flour was obtained from the USDA nutrient database. Restrictions imposed on the formulation included a maximum of 20% protein and 421-500 kCal/100g solids. Minimum essential amino acid contents were imposed as the recommended profiles for the target age group, and alpha linolenic acid content was restricted between 0.37 and 0.40 g/100 g. Based on these restrictions and inputs, a feasible formulation was generated.

Processing
The first step of the processing was to make a liquid formula from the mix by adding water; liquid formulation contained 20% of dry ingredients (that is about 20% solids). The liquid formulation was heated to near boiling to gelatinize the starch and denature protein in the mix.

Nutritional Profiles
The nutritional profiles of the formulation was compared with the RDA values recommended by the USDA.

Results

Table 1 shows the composition of the formulation generated in this work.

Table 1. Composition of the formulation

Ingredient	**Percentage composition**
Peanut flour (28% fat)	48.0
Brown rice flour	49.8
Flaxseed meal	2.2

The formulation is seen to be comprised of accepted food-grade GRAS ingredients. Sesame and the 12% fat peanut flour were rejected by the software in order to meet the imposed restriction for fat/energy and amino acid profile which was achieved by nearly equal amounts of 28% fat peanut flour and brown rice flour with a small amount of flaxseed meal to provide omega-3 fatty acid. The nutrient composition of the formulation along with the RDA recommended by the USDA are shown in Table 2. The liquid supplement developed in the present study seems to be well balanced in terms of the protein, carbohydrate, and fat contained and delivered. Energy is relatively low as this formula is not intended to meet the total nutritional requirements by itself. Energy could be increased by addition of more carbohydrate or healthy fat by substituting whole peanut or peanut oil into the available ingredients if desired. Indispensable amino acids delivered by a single serving of the formula(8 oz) range from 10% RDA for lysine to 30% for phenylalanine plus tyrosine. Arginine content is high and the arginine-to-lysine ratio is high as well.

Conclusions
This research has shown that a liquid *nutritional supplement* can be made from approximately 50% peanut flour and a few other easily available food ingredients by use of computer optimization and hydrothermal processing.

References

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Table 2. Composition of Peanut-Based Nutritional Supplement and Reference

Nutrient	**Estimated composition**	**% of daily RDA value**
Energy-calories (kcal)	180	8.2
Protein, crude	8.6g	15.4
Carbohydrate, crude	23.3g	17.9
Fat, crude	6.7g	9.6
Fiber, crude	4.5g	15
Sugars, total	0.42	-
Amino acids		
Methionine + cysteine	0.23g	16.4
Phenylalanine + tyrosine	0.79g	30.0
Lysine	0.31g	10.9
Tryptophan	0.091g	0.23
Threonine	0.3g	19.8
Isoluecine	0.32g	22.9
Histidine	0.22g	21.8
Valine	0.39g	21.8
Arginine	0.95g	10.6
Sodium	2.21mg	0.17
potassium	345.5mg	7.4
Alpha-linolenic acid	0.17g	10.6