Peanut Protein: A Versatile Food Ingredient

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ABSTRACT

Peanut flour has been evaluated for use in a variety of food products as a replacement for animal source proteins. In breakfast cereals and snack foods, peanut flour blends well with cereal flours to yield products with excellent flavor, texture, and color. Peanut flour can be used to produce textured vegetable protein or can be used directly in ground meats to provide good moisture and fat binding characteristics. In bakery products, peanut flour can be used at levels up to 20% to provide protein supplementation without the astringent flavor of other oilseed flours.

INTRODUCTION

Peanut flour, concentrates, and isolates have been receiving great attention from the food industry over the last several years (1). Low fat flours can be obtained from peanuts using a number of extraction techniques. The conventional crushing of peanuts, utilizing wet heat cooking and expelling of oil followed by solvent extraction, has been the subject of a previous report (2). Aqueous extraction of raw peanuts to obtain oil and protein has been described by Rhee et al. (3,4). Direct extraction of peanut slices to produce a low fat peanut flour has been reported by Fan et al. (5), Spadero et al. (6), and more recently by Swift & Co. (1).

Peanut concentrates and isolates can be obtained by conventional processes (7-9) involving isoelectric precipitation and/or alkali solution. Simultaneous aqueous extraction of oil and protein concentrates and isolates has also been described by Sugarman (10) and Rhee et al. (3,4).

Physical and chemical changes of peanut proteins due to dry and moist heating have been described in considerable detail. When using dry heat, Neucere (11) found a decrease in protein solubility as the temperature of treatment increased. Under wet heating conditions Neucere (11) and Cherry et al. (12) found a decrease in protein solubility at temperatures below 120 C and above 145 C. Cherry et al. (12) attributed this increase in solubility to denaturation and protein solubilization. McWatters and Cherry (13) found that wet heating improved emulsification and foaming capacities of whole peanuts. This improvement may be attributed to the peanut protein alone or to other peanut constituents.

Beuchat et al. (14) found that proteolysis with pepsin, bromelain, and trypsin caused an increase in protein solubility and water absoption, but destroyed the emulsion capacity of peanut protein.

Current commercial production is limited to conventional prepress and solvent extraction of edible peanut flour and grits (2). This investigation deals with practical food formulation work with this commercial product.

EXPERIMENTAL PROCEDURES

Processing

Peanut flour and grits utilized for this study were prepared from Runner peanuts which were dried to 3.5% moisture, split nut blanched, and electronically sorted to remove damaged or defective nuts. The prepress, solvent extraction of peanuts was conducted as described in an earlier report (2), and composition is listed in Table I.

Protein Fortified Cereals

A Wenger X-25 CF Extruder with five extruder heads was utilized: no. 1-spiral, no. 2-spiral, no. 3-straight, no. 4-spiral and no. 5-spiral. Steam locks were no. 1-small, no. 2-large, no. 3-large and no. 5-deep double flight cone. The straight die contained a 1 in. spacer. Two formulations were prepared as indicated in Table II. Cook (steam applied) was begun at the 3rd extruder head (product temperature 250 F) and was continued through the 5th head (product temperature 325 F). After production, the product was dried at 250 F for 12 min in a force draft drier. Finished composition of cereal products is indicated in Table II.

Organoleptic Evaluation of Cereals

Cereal samples were evaluated in lighted taste panel booths at 9:15 a.m. for each test. The Hedonic scale method was used with possible scores ranging from 1 to 9, 1 being "disliked extremely" and 9 being "like extremely." Milk and sugar were supplied in each booth for panelists to prepare the cereal to their individual tastes. All samples were triplet coded using random numbers and were served under red lights to mask any visual differences.

Protein Fortified Snacks

A Wenger X-20 Extruder with spiral extruder heads was utilized. Screws were no. 1-standard inlet, no. 2-5 standard double flight volume screws, and no. 6-shallow double flight spiral. A corn curl die was used, and cook was conducted only at the die. Due to the high protein content of the formulations tested, it was necessary to start the extruder with 100% degerminated corn meal. After steady

TABLE I

Composition of Peanut Flour and Grits

Chemical analysis	Flour (%)	Grits (%)
Protein (6.25 x N)[a]	60.0	60.0
Fat[a]	1.5	1.5
Fiber	3.5	3.5
Moisture	7.0	7.0
Ash	4.5	4.5
Total carbohydrates	27.0	27.0
NSI (protein solubility)	59.0	28.0
Physical characteristics		
Mesh size	95% –200 mesh	70% –20+65 mesh
Water absorption[b]	300% minimum	300% minimum
Color	cream	cream
Flavor	bland	bland

[a]As is basis.

[b]Modified (NSI) Nitrogen Solubility Index procedure in distilled water (2)

TABLE II

Cereal Formulations

Ingredients	Corn base (%)	Oat base (%)
Corn flour	50.0	20.0
Peanut flour	17.5	17.25
Oat flour	10.0	25.0
Soft spring wheat flour	8.0	12.0
Rice flour	6.75	18.0
Wheat germ	5.0	5.0
Malt syrup	2.0	2.0
Salt	0.5	0.5
Myvaplex 600	0.25	0.25
Finished composition		
Bulk density (dry) lb/ft^3	8.3	13.9
Protein (6.25 x N) (%)	21.2	22.1
Moisture (%)	2.4	6.6

TABLE III

Corn Curl Snack Formulations

Ingredients	A (%)	B (%)
Degerminated corn meal	85.0	30.0
Peanut flour	15.0	40.0
Rice flour		30.0
Composition before frying		
Bulk density (lb/ft^3)	3.8	8.1
Protein (6.25 x N) (%)	16.3	28.9
Moisture (%)	9.1	10.5

TABLE IV

Bread Formulations

Ingredients	White bread (%)	Whole wheat bread (%)
Bread flour	53.0	35.0
Whole wheat flour		16.0
Peanut flour	2.0	3.0
Water	39.0	37.0
Yeast	1.0	2.0
Shortening	2.0	2.0
Granulated sugar	2.0	
Invert syrup		4.0
Salt	1.0	1.0

TABLE V

Raised Doughnut Formulations

Ingredients	A[a] (%)	B[b] (%)
Water flour	46.0	46.0
Peanut flour	1.6	2.7
Granulated sugar	13.0	13.0
Whole eggs	11.0	7.0
Water	25.0	27.0
Shortening	4.0	4.0
Salt	0.2	0.2
Yeast	0.5	0.5
Doughnut spice blend	0.27	0.27

[a]Peanut flour replacement for nonfat dry milk.

[b]Peanut flour replacement for milk and partial replacement for whole eggs.

state production was attained with the corn meal, it was then feasible to ease into final formulations. After drying, the curls were fried in vegetable oil at 350-400 F for 5 seconds and seasoned. Formulations tested and compositions are indicated in Table III.

Textured Vegetable Protein

A Wenger X-25 CF Extruder was utilized with seven spiral extruder heads. Steam locks were no. 1-4 medium and no. 5-7 large. Screws were no.1-volume screw, no. 2-single flight, no. 3-6 double flight, and no. 7 double cut flight cone screw. Cook was begun at the 3rd head and continued to the 6th head. Product temperature at these heads was 225 F. The 7th head was cooled and product exited at 180 F. Peanut flour or peanut-soy blends could be prepared using this process.

Hamburger Formulations

Four formulations for beef hamburger patties were prepared. A control pattie which consisted of ground beef with salt and seasoning added in the same portions as the other formulations was prepared for comparison purposes. All formulations contained 70% beef (30% fat) with 30% combined water and extender. Beef was chopped through a 1/2 in. plate. Peanut grits (11.5%), textured vegetable protein (11.5%), soy protein concentrate (11.5% and 8.6%) were separately combined with 1.5% salt and seasoning and sufficient ice water to equal 30% and were allowed to hydrate for 15-20 min. Beef was blended with the hydrated mixture and passed through a 1/8 in. plate and then transferred to a pattie former. All preparation was conducted at product temperatures of 32-36 F.

Baking Tests

Baking studies using peanut flour at levels to replace milk or milk plus eggs were conducted with breads and doughnuts. The control sample in each test was prepared with nonfat milk solids. In the white bread formulation (Table IV) and in the raised doughnut formulation (Table V-A) peanut flour replaces the total nonfat milk solids. In the whole wheat bread formulation (Table IV), peanut flour replaces total nonfat milk solids and whole eggs. The raised doughnut formulation (Table V-B) represents the total replacement of nonfat milk solids and partial replacement of whole eggs by peanut flour. All products were mixed, scaled, shaped, and proofed according to usual methods. Doughnuts were deep fat fried at 375 F until golden brown and breads were baked at 375 F for approximately 35 min/1 lb loaf.

The Hedonic scale method was used for organoleptic evaluations. Flavor tests were conducted under red lighting to mask visual differences. Appearance tests were conducted under normal room lighting conditions.

RESULTS AND DISCUSSION

Corn and oat base cereals with bulk densities of 8.3 and 13.9 lb/ft^3, respectively, can be prepared using peanut protein to increase protein level to over 21%. The corn base formulation (Table II) received a Hedonic score of 6.1, which was comparable to commercial breakfast cereal scores. The oat base formulation (Table II) received a Hedonic score of 5.7 and had an unusual crunchy texture. The ease of expansion of prepress, solvent-extracted peanut flour (2) as well as its low flavor profile, allows peanut flour to be incorporated into breakfast cereals without substantial increase in bulk density or off flavor.

Corn curl type snacks with bulk densities of 3.8 to 8.1 lb/ft^3 can be prepared using peanut flour fortification of 15-40%. The lower level addition of peanut flour (15%) yielded a protein content of 16.3% before frying (Table III). This represents an 8% increase in protein content, wothout significant effect on bulk density or flavor. At the 40% peanut flour addition level, there was a substantial increase in density of the snack. The slightly bitter after taste could be masked with green onion seasoning to provide a crisp snack. Acceptable, slightly seasoned products with bulk densities below 4 lb/ft^3 could be obtained with up to 20% peanut flour. This would double the protein content of conventional commercial snack products.

Textured vegetable protein can be prepared from peanut flour or peanut flour in combination with other oilseed flours (2). The novel expansion characteristics and low flavor threshold of peanut flour could give additional versatility to textured soy products currently being marketed.

Peanut grits can be utilized in hamburger formulations with less flavor carry through than soy grits. When formulations were evaluated by panelists for raw and cooked appearance and for texture and flavor, patties made with peanut grits were judged either superior to those using soy protein or showed no significant difference in overall rating. The control and four pattie formulations were also tested for per cent weight loss and lateral shrinkage; they were weighed and measured before and after cooking:

$$\frac{[\text{Raw weight (or measure)} - \text{Cooked weight (or measure)}]}{\text{Raw weight (or measure)}} \times 100$$

$$= \%\ \text{weight loss or}\ \%\ \text{lateral shrinkage}$$

The following results were observed. The percent weight loss on the pattie samples were: peanut grits, 22%; textured vegetable protein, 26%, soy grits, 17%; low level soy grits, 22%; and control 25%. The percent lateral shrinkage on the five samples were: peanut grits, 7%; textured vegetable protien, 9%; soy grits, 7%; low level soy grits, 9%; and control, 14%.

Peanut flour utilized in baking studies to replace milk or milk plus eggs was found to contribute excellent properties to the products. Breads had a light, resilient texture, uniform brownness of crust, and very acceptable loaf volume. Doughnuts had a rich crumb and surface color. In flavor and appearance testing, panelists found no significant difference between the products prepared with nonfat milk solids and those prepared with peanut flour.

Rooney et al. (15) and Khan et al. (16) found that acceptable bread could be obtained when up to 20% of the wheat flour was replaced by peanut flour. When comparing peanut flours obtained by prepress, solvent extraction and aqueous extraction with full fat soy flour, Khan et al. (16) found loaf volumes, flavor and texture of peanut flours to be superior to full fat soy breads at comparable protein levels. Aqueous extracted peanut flour scored superior to prepress, solvent extracted peanut flour and full fat soy on crumb color and taste. None of the flavor panel members detected any peanut flavor at peanut flour levels of up to 20% replacement of wheat flour.

Peanut flour has some novel advantages for cereal, snack, textured vegetable protein, meat, and bakery applications. Work on frozen dessert, non-dairy and imitation dairy products (1) is underway. With consumer demands to control both food costs and increasing animal source protein value, peanut protein is emerging as a valuable addition to the oilseed protein market.

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