PEANUT SCIENCE

Volume 5 Fall 1978 Number 2

Utilization of Texturized Peanut Grits in Frankfurters[1, 2, 3]

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ABSTRACT

Texturized peanut grits were substituted at 0, 15 and 30% levels on a rehydrated basis for beef trimmings in the manufacture of frankfurters. Similar processing characteristics (peelability, cookout losses) were noted between the treatments. Frankfurters processed with 30% peanut grits exhibited a higher incidence of undesirable flavor, greater tenderness and lighter color than the control when evaluated by a trained sensory panel. Regardless of treatment, broiling and microwave cookery produced greater precision Penetrometer penetration of cross-sectional slices than what was observed when frankfurters were not cooked prior to testing. Compression of the outer surfaces of frankfurters with the Precision Penetrometer indicated a softening effect when broiling and microwave cookery were used *vs* no cooking only in the 15% peanut grit treatment. No explanation can be provided for this result. The 15% peanut grit formulation was the only one to display a significant (P>.05) increase in aerobic bacterial counts between 0 and 30 days of storage. The results from this study indicate that elevated levels of texturized peanut grits can be successfully incorporated into frankfurters from a sensory, physical and microbial standpoint.

Key Words: Texturized peanut grits, frankfurters, sensory, processing, penetration, compression, bacteria

The majority of studies dealing with the substitution of plant protein for skeletal muscle in processed meats have concentrated on soy protein. Schweiger (1970), Smith *et al.* (1973) and Lauck (1975) have reported improved processed meat product stability as a result of adding soy protein, although much of this stability is dependent on the level of fat in the product. Texturized soy protein levels in excess of 25% have been shown to create problems in emulsion stability (Sofos *et al.*, 1977). Both Cassens *et al.* (1975) and Terrell and Staneic (1974) found that soy flour imparted inferior microscopic structure and encapsulation properties. Undesirable flavors have been noted in meat products containing soy protein (Gremli, 1970; Schweiger, 1970; Smith *et al.*, 1973; Lauch, 1976; Ziprin and Carlin, 1976 and Sofos *et al.*, 1977).

Research information is quite limited concerning the use of texturized peanut grits in meat products. Several papers on the sensory and physical measurements of meat products containing peanut protein have been published in recent years (Hwang and Carpenter, 1975; McWatters, 1977). The sensory, physical and microbial characteristics of emulsified meat products formulated with elevated levels of peanut protein remains to be studied. This research was initiated to evaluatate these considerations by utilizing 15 and 30% substitution levels of texturized peanut grits for beef trimmings in frankfurter formulations.

Materials and Methods

Processing

Texturized defatted peanut grits (60% protein-dehydrated basis) were substituted at the 0, 15 and 30% levels for beef trimmings in the manufacture of frankfurters. Beef trimmings (17 % protein) were obtained from U.S.D.A. Utility cow chucks, shanks and plates. Pork trimmings (80% fat) were utilized in the formulations for purposes of creating a 30% fat level in all treatments. The formulations for the three treatments are shown in Table 1. Frankfurters were processed at four separate times over a period of a year.

Peanut grits were rehydrated at a 2:1 ratio of water to dry material. Emulsions were prepared in a Hobart (Model 8181D) silent cutter. One-half of the beef trimmings (orginally ground through a 0.97 cm plate), one-fourth of the pork trimmings, one-half of the ice, one-fourth of the water and all of the salt, seasonings and nitrite were chopped for 5 min. in the silent cutter. Then, the remaining beef, pork, ice and water along with the peanut grits were added to the chopper and the emulsions were chopped until the temperature reached 16 C. Emulsions were stuffed into 20-21 cm cellulose casings using 13.6 kg pressure. Following linking, the frankfurters were placed in a smokehouse preheated to 60C. The smokehouse temperature dropped to 54 C following placement of the frankfurters into the smokehouse and this temperature was maintained for the first 30 min, of the smoking cycle. Dense hickory wood smoke was introduced into the smokehouse during this time period. The smokehouse temperature was then elevated approximately 1.2 C every 5 min. until a smokehouse temperature of 65 C was attained. This temperature was maintained until the internal temperature of the frankfurters reached 63 C, which corresponed to an approximate total smoking and heating period of 2.5 hr. The frankfurters were rinsed with cold water until the internal product temperature dropped to 43 C at which time they were hung at 10 C for one hr. prior to obtaining post-cooking weights.

The frankfurters were hand-peeled 24 hr. after smoking and cooking and were subjectively appraixed for ease of peeling using a four-

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Table 1. FORMULATIONS FOR FRANKFURTERS

Ingredients and percent usage	Level of peanut grits in the formulation, %		
	0	15	30
Beef trimmings (60% lean - 40% fat)	63.0	37.0	8.0
Pork trimmings (20% lean - 80% fat)	10.0	21.0	35.0
Texturized peanut protein grits[a]	0.0	15.0	30.0
Ice	14.0	14.0	14.0
Water	10.0	10.0	10.0
Salt	2.2	2.2	2.2
Sugar	0.4	0.4	0.4
Seasonings[b]	0.4	0.4	0.4
Nitrates	126 ppm	126 ppm	126 ppm

[a]Texturized peanut grits were added in the rehydrated state. (Two parts of water to one part peanut protein) Texturized peanut protein grits manufactured by Gold Kist Lab., Lithonia, Ga.

[b]Heller's Weiner Seasoning (GC-1059)

point scale where 4 = 75 to 100% of the frankfurters peeled with no difficulty, 3 = 50 to 75% of frankfurters peeled with no difficulty, 2 = 25 to 50% of the frankfurters peeled with no difficulty and 1 = 0 to 25% of the frankfurters peeled with no difficulty. The degree of fatting out of frankfurters was also subjectively assessed using a four-point scale where 4 = 75 to 100% of the frankfurters displayed no visible fatting-out, 3 = 50 to 75% of the frankfurters showed no fatting-out, 2 = 25 to 50% of the frankfurters showed no fatting-out and 1 = 0 to 25% of the frankfurters with no fatting-out. The consumer cook-out test was employed with frankfurters following the procedures of Tauber and Lloyd (1947).

Proximate Analysis

Proximate analysis for moisture, fat and ash was performed on duplicate 5 g samples of frankfurters per treatment each time replicate batches were prepared. AOAC (1970) procedures were used with protein determined by difference.

Sensory Panel Evaluations

A trained ten-member sensory panel evaluated cooked 1.4 cm long frankfurter sections for chewiness, texture, juiciness, color, flavor intensity and presence and type of undesirable flavor. The scaling systems for these sensory attributes are provided as footnotes to Table 3. This panel had previously evaluated other processed meats and members were selected on their ability to be discernible and repeatable in evaluating sensory attributes. Frankfurters were prepared for sensory evaluation by heating in boiling water for two min. Panelists were served 25 C water and unsalted crackers between samples.

Penetration and Compression Values

Penetration and compression values for frankfurters were determined using the Precision Penetrometer machine. Penetration values were obtained on 50 mm cross-sectional slices using a 4 mm wide, 8.5 g plunger with 100 g of added weight. Compression of the skin surface of frankfurters was ascertained using a 13 mm wide, 17 g plunger with 150 g of added weight. Values were recorded as mm of penetration and compression.

The effect of cooking method was studied in relation to physical measurements of penetration and compression. The four separate cooking methods that were used, consisted of (1) no cooking beyond the smokehouse cycle, (2) boiling, (3) broiling and (4) microwave cookery. Samples designated for boiling were cooked for two min. in boiling water. The broiling procedure involved heating frankfurters on an oven broiler rack for one min. followed by a 180 degree rotation of the frankfurters before heating for an additional min. in an oven maintained at 260 C. Frankfurters heated by microwave were placed in a microwave oven (2540 MHZ, 115 V) for 1.5 min.

Aerobic Bacterial Counts

Aerobic bacterial determinations were made following a procedure similar to that described by Yokoya and Zalykk (1975). Assessments were performed following 0, 15 and 30 days of product storage in vacuum packaged polyvinyldine chloride bags at 6 C. Samples were obtained from various locations in frankfurter sections sliced lengthwise. These samples were blended for one min. with sterile Butterfield's phosphate buffer as the diluent. Dilutions (10^2, 10^3) of these mixtures were placed into petri dishes followed by the addition of standards methods agar. Plates were incubated for 48 hr. at 32 C prior to enumeration.

Statistical Analyses

Data were analyzed by analyses of variance. Duncan's new multiple range was employed to test the significance of means obtained from significant ($P>.05$) F values (Steel and Torrie, 1960). Where significant interactions occurred, the interaction means were subjected to mean separation analyses and the main effect means are deleted from Tables 4 and 5.

Results and Discussion

Processing characteristics and chemical composition values for frankfurters are given in Table 2. While substan tial differences appear to exist in certain characteristics (consumer cookout losses, peelabilty), variation within treatment prevented statistical significance ($P>.05$). However, a trend was noted for lower consumer cookout losses to be associated with increased substitution of peanut protein into the formulation. McWatters (1977) found ground beef manufactured with 15% defatted peanut flour to have lower total cooking losses than control ground beef, while Hwang and Carpenter (1975) reported no differences in the cooking shrinkage of meat loaves containing peanut flour in comparison to control product. In the latter study, it was concluded that protein additives perform excellent functions in holding water during early stages of loaf preparation, but the absorbed water is lost during the heating process, thus causing a high cooking loss. Since research in formulations dealing with plant protein additives in meat products varies greatly as to type of product (emulsified cooked, fresh ground, loaves), method of processing and portein type and level used, extreme care must be exerted in interpreting the varied results. In the present study, total protein percentage increased with peanut grits addition, while the other proximate analysis components were not affected by treatment formulations.

Both the 15 and 30% peanut protein frankfurters exhibited a greater incidence of undesirable flavors as compared to the control product (Table 3). However, total flavor intensity, as determined by sensory panel did not differ between treatments. A definite deterioration in flavor as a result of increased substitution (5, 10, 15%) of peanut protein in ground beef was reported by McWatters (1977). Meat products containing soy have also been found to possess undesirable flavors (Gremli, 1970; Scheiger, 1970; Smith *et al.*, 1973; Lauch 1096; Ziprin and Carlin, 1976 and Sofos *et al.*, 1977). Comments by panelists indicated a trend for more

Table 2. PROCESSING CHARACTERISTICS AND CHEMICAL COMPOSITION FOR FRANKFURTERS.

	Level of peanut grits, %		
Item	0	15	30
Smokehouse losses, %	11.4	13.4	10.6
Consumer cookout test losses, %	7.3	5.0	3.7
Frankfurter peelability score	4.0	4.0	2.7
Degree of fatting out score	2.7	3.7	2.5
Fat, %	28.6	32.3	29.4
Moisture, %	54.3	49.5	49.0
Ash, %	2.8	2.6	2.4
Protein, %	14.2[a]	15.6[a,b]	19.3[b]

[a,b]Means on the same line bearing different letters are significantly (P<.05) different.

musty and cereal-like flavors in frankfurters containing peanut grits. Maga and Johnson (1972) claimed that storage and processing of products containing soy changed the lipid components in soy resulting in their autooxidation and resultant bitter and musty off-flavors. Since 30 days were required to complete the sensory evaluation in the present study, some flavor components might be partially attributable to storage.

The 30% peanut frankfurters were classified as being less chewy or more tender than the 0 and 15% peanut frankfurters. It has been concluded that (Rakosky, 1974, Sofos *et al.*, 1977) firmness or hardness in a sausage product is dependent on the amount of lean meat, whereas excessive amountsof texturized soy protein have a tenderizing effect on the product. However, these tenderizing effects were not found in meat loaves containing texturized vegetable protein (Yoon *et al.*, 1974) and peanut protein (Hwang and Carpenter, 1975). These differences could be due to structural variations between frankfurters and loaves or the lower hydration ratios used in loaf formulations. Higher water and fat retention capabilities of peanut protein have been attributed as a major cause of reduced texture preference in ground beef possessing peanut flour (McWatters, 1977).

As expected, the 30% peanut protein frankfurters were given scores indicating lighter color than the control product, however, the 15% peanut frankfurters did not differ from the control in color scores. McWatters (1977) found 15% peanut ground beef to be significantly (P>.01) lighter in sensory panel color ratings than ground beef processed without peanut protein. Sofos and Allen (1977) demonstrated that acceptable color in frankfurters could be obtained at high soy levels if soy replaced the fat rather than the lean components.

Both cooking method and level of peanut protein substitution yielded significant (P<.05) influences on penetration values obtained with the Precision Penetrometer (Table 4). Broiling resulted in greater penetration of interior cross-sectional slices of frankfurters than boiling or no cooking in all three treatments. Broiling would further

Table 3. SENSORY RATINGS FOR FRANKFURTERS.

	Level of peanut grits, %		
Sensory attribute	0	15	30
Flavor intensity[c]	4.0	3.9	4.0
Presence of undesirable flavors	1.7[a]	2.3[b]	2.4[b]
Chewiness[e]	3.4[a]	3.7[a]	4.4[b]
Texture[f]	2.1	2.3	2.5
Juiciness[g]	3.3	3.3	3.4
Color[h]	3.2[a]	3.2[a]	1.8[b]

[a,b]Means on the same line bearing different superscripts are significantly (P<.05) different.

[c]Based on a 7-point scale of 1 = imperceptible, 7 = very pronounced.

[d]Based on a 6-point scale of 1 = none, 6 = intense.

[e]Based on a 5-point scale of 1 = tough, 5 = tender.

[f]Based on a 5-point scale of 1 = gritty, 5 = fine.

[g]Based on a 5-point scale of 1 = dry, 5 = juicy.

[h]Based on a 5-point scale of 1 = pale, 5 = dark.

harden and coagulate surface protein, serving to maintain internal moisture and fat. This would allow for higher penetration values in frankfurters cooked by broiling in contrast to boiling or non-cooking. Microwave cookery produced less penetration than broiling only in the 30% peanut frankfurters. Frankfurters processed with 30% peanut grits displayed higher penetration values than 15% peanut grit frankfurters when boiled or broiled. Since less salt extractable and coagulable myosin would be present in the 30% peanut protein frankfurters, higher penetration values might be expected. A similar situation was noted for shear force values of ground beef patties containing increased levels of peanut meal (McWatters, 1977) while Hwang and Carpenter (1975) reported greater resistance to Instron multi-bladed shear as a function of increased peanut protein in meat loaves.

Table 4. PRECISION PENETROMETER PENETRATION AND COMPRESSION VALUES FOR FRANKFURTERS.

	Level of peanut grits, %		
Value[e], cooking method	0	15	30
Penetration - uncooked	2.6[a]	3.0[a]	2.9[a]
Penetration - boil	4.4[a,b]	2.9[a]	5.4[b,c]
Penetration - broil	6.9[c]	6.1[b,c]	9.6[d]
Penetration - microwave	5.8[b,c]	7.1[c]	6.9[c]
Compression - uncooked	3.2[a]	3.8[a]	3.3[a]
Compression - boil	4.4[a,b]	4.3[a,b]	6.1[b]
Compression - broil	4.7[a,b]	6.2[b]	4.5[a,b]
Compression - microwave	4.6[a,b]	6.1[b]	5.3[a,b]

[a,b,c,d]Means in the same row and column within penetration and compression bearing different superscripts are significantly different (P<.05).

[e]Values in mm.

Broiling and microwave cookery of 15% peanut frankfurters yielded greater compression than the non-cooked samples when tested by the Precision Penetrometer. At the 30% peanut grits level, boiling produced higher compression values than no cooking. Non-significant differences (P>.05) occurred between the three levels of peanut grits in frankfurters for compression regardless of the method of cookery. The above results along with those of other studies confirm the need for additional research on methods of cooking with meat products containing various types and levels of plant protein.

Aerobic bacterial counts did not change appreciably as a result of storage or increasing level of peanut grits (Table 5). The only significant (P>.05) difference was a higher count for 15% peanut frankfurters following 30 days of storage in contrast to 0 days storage.

Table 5. AEROBIC BACTERIAL COUNTS FOR FRANKFURTERS

Bacterial type, Days of product storage	Level of peanut grits, %		
	0	15	30
Aerobic bacterial counts[c] - 0 days	$2.0^{a,b}$	1.6^{a}	$2.1^{a,b}$
Aerobic bacterial counts[c] - 15 days	$2.7^{a,b}$	$2.2^{a,b}$	$2.1^{a,b}$
Aerobic bacterial counts[c] - 30 days	$3.4^{a,b}$	3.7^{b}	$2.8^{a,b}$

[a,b]Means in the same rows and columns bearing different superscripts are significantly (P<.05) different.

[c]Bacterial counts ($\log_{10}$) per gram of sample.

Only minimal product problems were noted in this study involving the incorporation of elevated levels of texturized peanut protein into frankfurters. These problems were musty and cereal-like flavor, soft texture and pale color. However, the use of larger quantities of plant protein in emulsified products beyond that currently being added appears feasible, since processing characteristics, many palatability attributes and microbial considerations were not detrimentally influenced by the addition of peanut grits. Presently, governmental support programs and cost of processing do not favor the usage of peanut protein as compared to soy protein in meat products. However, on a comparable protein basis, present price differentials between soy protein concentrate and peanut proteins are not that substantial. If governmental support for peanut production were lifted, peanut materials would probably become more competitive with soy protein.

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Accepted May 23, 1978