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Palatability of Ground Beef Patties Containing Peanut Meal, Structured Soy Protein, and Mechanically Processed Beef

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ABSTRACT

Ground beef patties containing, varying levels of peanut meal, structured soy protein fiber, and mechanically processed beef were formulated. A trained sensory panel evaluated patties for differences in tenderness, juiciness, and cohesiveness. Tenderness was also evaluated with the Universal Instron Testing Machine. Addition to MPB of PM alone increased the tenderness and cohesiveness of ground beef patties but did not affect juiciness. Addition of SPF decreased tenderness and juiciness but did not affect the cohesiveness of ground beef patties. Formulations containing SPF had less cooking loss than formulations without SPF.

Key Words: Ground beef, peanut meal, structured soy protein, mechanically processed.

Sufficient animal protein is available to supply the nation's protein requirement, but, socio-economic circumstances may cause an uneven distribution among the population (1). Also, even in an affluent society such as ours, questions arise concerning the waste of useful products. Therefore, much attention has recently been given to methods of recovering and utilizing various kinds of proteins in ground and comminuted meat products.

Bird (1) estimated that by 1980 about two million pounds of meat will be replaced by various plant proteins. Most agree that soy protein is and will remain the most widely used of these plant protein additives for ground beef production. Obviously, the most important factor affecting this usage is palatability. Mize (11) and Twigg *et al.* (12) studied the palatability of ground beef patties containing 2-30% soy protein. The effect of family income upon consumer acceptance of such soy protein-containing patties was also studied. These studies showed that addition of various soy proteins to ground beef is feasible in terms of consumer acceptance. Tenderness was improved with the addition of soy, (11, 3, 9, 12) and other sensory panel parameters were minimally affected. A major concern, however, is that excessive substitution of plant protein for meat may make the product mushy. Commercial advertisements for some soy additives claim that additives increase the textural desirability of meat products. Research in this area has not been completely limited to soy protein. Other plant proteins, such as peanut meal, have been tested. McWatters (10) found that patties containing steam-heated peanut meal were similar in palatability to all-beef patties containing soy protein additives.

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Mechanical deboning or processing of beef has been suggested as a means of reducing protein waste by recovering meat and marrow from bones (7, 8). Many large packing facilities at one time were equipped with mechanical deboning machines. Cross *et al.* (4) reported that sensory panel members preferred ground beef patties containing 20% added mechanically processed beef (MPB) to the controls. Excessive incorporation of MPB may also cause the product to be mushy.

The objective of this study was to determine the effects of two plant proteins and MPB upon ground beef texture. The plant proteins were from soy and peanut meal.

Materials and Methods

Product Formulation

Samples (13 kg) were prepared according to the formulations listed in Table 1. USDA Choice grade chucks were the source of beef. Structured soy protein fiber (SPF) supplied by the Protein Division of the Ralston Purina, St. Louis, Missouri, was the soy additive and was added to the formulations on a dry weight basis. The peanut meal (PM) was Nutrex Precooked peanut flakes marketed by the World Protein Corporation, and obtained through the Food Science Department at Clemson University.

The beef for all 15 treatments was initially ground through a 2.54 cm plate in a Hobart Mixer-Grinder (model 4346). Appropriate levels of MPB, SPF, and flaked PM were added. The formulation was mixed for 1 minute, ground through a 1.90 cm plate, mixed for 1 minute, and finally ground through a .32 cm

Table 1. Product formulation

Treatment	% Beef	% MPB[a]	% SPF[b]	% PM[c]
1	100			
2	80	20		
3	70	30		
4	95		5	
5	90		10	
6	95			5
7	90			10
8	75	20	5	
9	70	20	10	
10	75	20		5
11	70	20		10
12	65	30	5	
13	60	30	10	
14	65	30		5
15	60	30		10

[a]MPB = mechanically processed beef

[b]SPF = structured soy protein fiber

[c]PM = peanut meal

plate. In order to standardize the fat content in all formulations, fat trimmed from the chucks before they were ground was used to adjust the fat content to levels similar to those formulations not containing plant proteins. Fat content was monitored via ether extract and ranged from 24% to 32%. Patties weighing 114 g and .95 cm in thickness were prepared in a Hollymatic patty machine (model 200). Patties were individually wrapped in freezer paper and frozen at -20°C until needed.

Trained Panel

An eight member sensory panel, trained by the procedures of Cross *et al.*, (5) evaluated samples from each treatment in a total of 15 sessions; six samples were evaluated per session. The control was repeated 11 times and the treated groups either 5 or 6 times as determined by a random numbers table. The parameters evaluated were: tenderness (8 = extremely tender, 1 = extremely tough); juiciness (8 = extremely juicy, 1 = extremely dry); and cohesiveness (8 = extremely cohesive, 1 = extremely uncohesive). Due to the particle size and texture of MPB, addition of large amounts to ground beef could lead to a "mushy" product (4). This concern also applies to some plant proteins (3). The sensory panel was trained to evaluate those possible differences as cohesiveness. Patties served to the sensory panel were cooked from the frozen state on electric Faberware broilers (275 C) for five minutes per side.

Cooking Losses and Shear

Cooking loss from the frozen to the cooked state was determined by weighing ten patties per treatment before and after cooking. Each patty was sectioned into four 2.54 cm squares and pictorially scored for degree of doneness (color photographs with 1 = well done and 8 = rare). Maximum shear was determined for each section by use of the Instron single blade technique of Cross *et al.*, (5).

Statistical Analysis

Sensory panel mean values for each of the 15 treatment formulations were tested for significant differences by the analysis of variance (ANOVA) followed by Duncan's multiple range test (6).

Results and Discussion

Tenderness

Mean values from the trained sensory panel for tenderness are listed in Table 2. In agreement with Cross *et al.*, (4) ratings for tenderness were significantly (P<.05) higher for patties containing 30% MPB than the mean value of the control product. Patties containing 20 or 30% MPB did not differ in tenderness. The mean value of 5.1 for the control treatment approached an unacceptable level of tenderness. Overall, the addition of PM significantly (P<.01) improved tenderness, but patties containing 5% PM were similar to the control. Patties with 10% PM were rated significantly (P<.05) more tender than the control. Overall, the addition of SPF to the formulation significantly (P<.001) decreased tenderness ratings (increased toughness). Patties containing SPF at both the 5% and 10% levels were rated less tender than the control and patties containing either MPB or PM alone. Those differences often were large enough to be important.

The addition of MPB at both the 20% and 30% levels improved the tenderness of patties containing 5% or 10% SPF. This improvement was significant

Table 2. Sensory and physical measurements of tenderness subjected to Duncan's Multiple Range test.

Formulation	Descriptive panel tenderness	Instron force (newtons)
Control (100% beef)	5.1^{e-i}	111.15^{b}
20% MPB	5.5^{c-f}	93.95^{d}
30% MPB	6.2^{a-c}	71.08^{f}
5% SPF	4.8^{fg}	119.85^{a}
10% SPF	3.9^{h}	124.53^{a}
5% PM	5.2^{d-g}	104.60^{bc}
10% PM	6.0^{a-d}	102.43^{c}
20% MPB; 5% SPF	5.2^{d-g}	97.05^{cd}
20% MPB; 10% SPF	4.6^{gh}	85.45^{e}
20% MPB; 5% PM	6.1^{a-c}	77.23^{ef}
20% MPB; 10% PM	6.0^{a-d}	79.00^{ef}
30% MPB; 5% SPF	5.6^{c-f}	74.88^{f}
30% MPB; 10% SPF	5.6^{b-e}	73.08^{f}
30% MPB; 5% PM	6.4^{ab}	72.05^{f}
30% MPB; 10% PM	6.6^{a}	62.48^{g}

[a-i]Means in the same column bearing an identical letter in the superscript do not differ (P<.05).

(P<.05) for the 10% SPF/30T MPB combination as compared to 10% SPF alone. The improvement in tenderness was also significant between 10% SPF/30% MPB and 10% SPF/20% MPB. Tenderness for patties containing 5% PM was significantly improved with the addition of either 20% or 30% MPB, but this was not the case for the 10% PM level. However, the combination of 10% PM plus 30% MPB yielded the highest mean tenderness value of any treatment.

Our data from tenderness evaluations suggest that: (1) addition of MPB and/or PM improved tenderness, (2) SPF decreased tenderness, and (3) the addition of MPB to SPF formulations tended to offset the negative effect of SPF. These conclusions are supported by ratings of the trained sensory panel and by the Instron measurements of maximum shear force.

Juiciness

Mechanically processed beef did not have a significant effect on juiciness (Table 3). Mean values for patties containing 0% (control), 20% and 30% MPB did not differ. Furthermore, addition of PM did not significantly affect sensory panel juiciness scores. Mean values for juiciness did not differ between 0% (control), 5% and 10% PM. Addition of SPF to the ground beef patties significantly (P<.001) decreased sensory panel juiciness scores. Patties with 10% SPF were rated significantly lower in juiciness than the patties with 0% (control) or 5% SPF. The negative effect of SPF on juiciness might be attributed to the low pH of the SPF additive. During processing of the SPF, carbohydrate is removed, the soy flour is acidified, the protein precipitate is collected, and the fiber is pressed and formed from the precipitate. The pH of SPF remains near the isoelectric point of the soy and upon addition to ground beef could tend

Table 3. Mean values for juciness and cohesiveness subjected to Duncan's Multiple Range test.

Formulation	Descriptive panel juiciness	Descriptive panel cohesiveness
Control (100% beef)	5.8^{a-d}	4.8^{f}
20% MPB	5.6^{a-e}	5.2^{c-f}
30% MPB	6.0^{a-c}	5.6^{a-d}
5% SPF	5.4^{de}	5.1^{d-f}
10% SPF	4.7^{f}	4.8^{f}
5% PM	5.6^{a-e}	4.7^{f}
10% PM	5.6^{a-e}	5.4^{b-e}
20% MPB; 5% SPF	5.4^{c-e}	5.2^{c-f}
20% MPB; 10% SPF	5.0^{ef}	5.0^{ef}
20% MPB; 5% PM	6.1^{ab}	5.8^{ab}
20% MPB; 10% PM	5.5^{b-e}	5.7^{a-c}
30% MPB; 5% SPF	5.4^{c-e}	5.5^{a-d}
30% MPB; 10% SPF	5.7^{a-d}	5.4^{b-e}
30% MPB; 5% PM	6.2^{a}	6.1^{a}
30% MPB; 10% PM	5.7^{a-d}	5.9^{ab}

[a-f]Means in the same column bearing an identical letter in the superscript do not differ (P<.05).

Table 4. Mean Values for degrees of doneness, cooking losses and chemical analysis of uncooked patties

Formulations	Degree of doneness	Cooking losses (%)	Fat (%)	Moisture (%)
Control (100% beef)	3.2^{gh}	35.4	25.5^{c}	53.0^{h}
20% MPB	3.3^{h}	34.7	29.5^{fg}	51.5^{f}
30% MPB	2.4^{c}	34.5	32.4^{h}	48.6^{c}
5% SPF	3.1^{g}	30.9	26.7^{de}	53.3^{hi}
10% SPF	2.7^{de}	30.6	23.9^{b}	56.7^{j}
5% PM	2.8^{ef}	34.2	32.2^{h}	43.7^{b}
10% PM	3.9^{i}	32.2	26.1^{cd}	54.4^{i}
20% MPB; 5% SPF	3.1^{g}	30.9	29.8^{fg}	50.3^{d-g}
20% MPB; 10% SPF	2.9^{f}	30.2	29.1^{f}	50.0^{d-f}
20% MPB; 5% PM	2.4^{c}	31.4	26.0^{cd}	55.7^{j}
20% MPB; 10% PM	2.7^{de}	35.0	30.3^{g}	49.5^{c-e}
30% MPB; 5% SPF	2.2^{b}	31.2	29.9^{fg}	51.0^{fg}
30% MPB; 10% SPF	2.2^{b}	29.4	31.9^{h}	44.0^{b}
30% MPB; 5% PM	2.6^{d}	32.1	27.6^{e}	53.8^{hi}
30% MPB; 10% PM	2.7^{de}	33.3	32.4^{h}	49.0^{cd}

[a]Scored pictorially with 1 = well done and 8 = rare.

[b-h]Means in the same column bearing an identical superscript do not differ (P<.05).

to dry the formulation. Combining SPF with MPB generally improved sensory panel juiciness over that of SPF alone.

Cohesiveness

MPB was significantly (P<.05) linear in its effects on sensory panel cohesiveness (Table 3). Patties containing 30% MPB differed significantly from the control (more cohesive). Patties containing 20% MPB were similar to both 30% MPB and the all beef control. The addition of SPF alone did not significantly affect cohesiveness. Combination of SPF with 30% MPB resulted in a significant (P<.05) increase in cohesiveness ratings in some of these same comparisons. Also, patties containing 30% MPB with only 5% SPF differed significantly in cohesiveness (P<.05) from those containing 20% MPB and 10% SPF. Patties containing 10% PM had significantly (P<.05) larger mean values for cohesiveness than those containing 5% PM or the control. Combinations of PM and MPB resulted in significantly (P<.05) greater cohesiveness ratings than patties containing 0% or 5% PM alone.

Cooking Properties

Addition of higher levels of MPB or SPF alone resulted in lower ratings for degree of doneness (Table 4). These decreases were significant (P<.05) between MPB levels of 30% and 20% and control. Similarly, the ratings were significantly lower for 10% than 5% SPF and the control. However, the ratings for 10% PM were significantly higher (less well done) than 5% PM. Although data were not treated statistically, formulations containing SPF appeared to have sustained less cooking loss than formulations without SPF (Table 4).

Conclusions

Conclusions based on these data are: (1) addition of MPB or PM alone increased the tenderness and cohesiveness of ground beef patties but did not affect juiciness, (2) addition of SPF decreased tenderness and juiciness but did not affect the cohesiveness of ground beef patties and (3) formulations containing SPF had less cooking loss than formulations without SPF.

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