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GRANULAR SOY PROTEIN CONCENTRATE AS AN EXTENDER FOR GROUND BEEF

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The Department of Defense is interested in the use of vegetable protein to reduce the amount and cost of beef procured by the Armed Forces. This study was undertaken to determine the storage stability and consumer acceptability of extended ground beef, soy protein concentrate blends having hydrated soy levels of 10 and 20 percent by weight. The prepared blends were stored at 0°F (17.8°C) and withdrawn for evaluation after 3, 6, 9 and 12 months storage. For evaluation, the blends were prepared as meat loaf and hamburger sandwiches in

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(20) accordance with standard Armed Forces recipes. Sensory evaluation by a consumer test panel using a 9-point sensory quality scale showed that neither time in storage nor composition of the ground beef soy protein concentrate blends had any effect upon the acceptability of the products tested. It was concluded that the use of ground beef soy protein blends can reduce the amount and cost of beef procured by the Armed Forces without a reduction in the quality and acceptability of finished product served to the troops.

PREFACE

This study was conducted to determine the consumer acceptability of ground beef soy protein concentrate blends at hydrated soy levels of 10 and 20 percent after 3, 6, 9 and 12 months storage at 0°F (-17.8°C).

The authors wish to acknowledge the assistance of SFC Jacob Humann and SSG Paul Normand, Experimental Kitchens Branch, Food Engineering Laboratory, who prepared the samples for serving to the consumer test panel.

This effort was undertaken under Project No. 03146923000 Military Food Service and Subsistence Technology.

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INTRODUCTION

The food industry is actively pursuing the use of vegetable protein as an ingredient that can extend and improve the cost, nutrient and sensory properties of more expensive foods such as meat, fish, and poultry. Vegetable proteins are obtained and processed from high protein plant sources that are in abundant supply. Industrial development has been heavily focused on the utilization of the soybean as a primary source of vegetable protein. Vegetable protein processed from the soybean is available as a flour, concentrate or isolate, in various textures and is extensively used as an economic source of highly nutritious protein. Textured soy protein is specially processed to simulate the expanded fibers of meat and is an excellent protein supplement for a variety of meats. Soy protein combined with beef extends the meat supply and lowers cost without sacrificing nutritional quality.

The Food and Nutrition Service of the U.S. Department of Agriculture has established regulations for the use of vegetable proteins as an extender in meat alternatives for Type A lunches under the National School Lunch Program in which over 25 million school children participate.

The Department of Defense is interested in the use of vegetable proteins to assist in efforts to reduce the amount and cost of beef procured by the Armed Forces. The Armed Forces procure approximately 51 million pounds of ground beef per year. The cost for this product is currently about 67 million dollars. The addition of soy protein at a 10 or 20 percent level would decrease raw beef requirement by 5 million or 10 million pounds, respectively,

per year. As a general rule, ground beef soy protein blends reduce the cost of the finished product 1 percent for each 1 percent of hydrated soy protein concentrate added to the mix. At the current procurement price for ground beef, $1.33/lb., and rehydrated granular soy protein, $0.10/lb., a ground beef soy protein blend containing 20 percent by weight of hydrated soy protein concentrate would generate annual savings of approximately 13 million dollars.

This study was undertaken to evaluate and determine the storage stability and consumer acceptability of ground beef soy protein concentrate blends stored at 0°F (-17.8°C) and withdrawn for evaluation after 3, 6, 9, and 12 months storage.

EXPERIMENTAL PROCEDURES

A. Production of Test Product

A production test was conducted at a commercial meat processing plant to produce bulk ground beef and ground beef patties containing hydrated granular soy protein concentrate at 10 and 20 percent levels by weight. The ground beef material used for the blend was prepared in compliance with LP/P DES 35-75.[1] The fat content was carefully monitored and controlled at a maximum level of 22 percent. The vegetable protein used for the blend was a commercial granular soy protein concentrate containing highly functional protein and having a low flavor profile. A typical analysis of the soy protein concentrate used is as follows:

Moisture	6.0%
Protein (Moisture-free basis)	71.5%
Fat (ether extraction)	0.3%
Crude fiber	3.5%
Ash	5.3%
Carbohydrates (by difference)	17.7%
pH	6.8
P.E.R.	2.0

The granular soy protein concentrate was hydrated and prepared for use according to the manufacturer's instructions. The slurry contained 3 parts water and 1 part soy protein concentrate by weight.

[1] Limited Production Purchase Description LP/P D 35-75, Beef, Ground, Frozen, Soy Protein Added, 1975.

To prepare the meat/soy protein concentrate blends the raw beef was flaked in an Urschel Comitrol unit using a No. 750J cutting head. * The flaked meat pieces were then blended in a mechanical blender for 1½ minutes, tested for fat content and the mixture adjusted as required to meet fat requirement. ** The soy protein concentrate-water slurry was added to the meat and blended for another two minutes. The blend was then ground through a meat grinder equipped with an extrusion plate having holes with 0.125 inch diameter. Dry ice was added at each processing step, as required, to maintain a temperature in the blend of 36 to 40°F (2.2 to 4.4°C). Approximately thirty thousand pounds of product, made in 1,000 pound batches, produced the following blends:

Bulk Blend				Cases
Ground Beef	90%	Soy Protein Concentrate	10%	180
Ground Beef	80%	Soy Protein Concentrate	20%	180

Patty Blend				Cases
Ground Beef	90%	Soy Protein Concentrate	10%	146
Ground Beef	80%	Soy Protein Concentrate	20%	146

A total of eight cases, two from each blend, were randomly selected from each production batch as shown in Table 1. The cases were delivered to NATICOM, placed in storage at 0°F (-17.8°C), and removed at 3-6-9 and 12-month intervals for acceptance testing by a consumer test panel.

* Comitrol Model 3600, Urschel Laboratories, Valparaiso, IN 46383

** Fat content was analyzed by means of an Anyl-Ray Fat Analyzer, Anyl-Ray Corporation, Waltham, MA 02154

acceptance testing by a consumer test panel.

TABLE 1

Random Selections of Test Product from Production Batches of Bulk Ground Beef and Ground Beef Patty Blends Containing 10 and 20 Percent Hydrated Soy Protein Concentrate.

Item	Soy level	Batch No.	Box No.	Weight
Patty	10%	1	273	34
	10%	1	274	34
	20%	2	55	34
	20%	7	224	34
Bulk	10%	1	11	55
	10%	1	17	55
	20%	7	143	55
	20%	7	151	55

B. Preparation of Test Blends for Consumer Test Panel

Each of the two bulk ground beef blends was tested in meat loaf prepared according to Armed Forces Recipe L-35. [2] Each of the two beef patty blends was tested in hamburger sandwiches prepared according to Armed Forces Recipe N-29 [2]

[2] Technical Manual 10-142, Armed Forces Recipe Services, Feb. 1969.

with the exception that the patties were grilled 3 minutes per side instead of 4 minutes, because they browned more rapidly than pure meat patties.

The two bulk blends and the two patty blends were tested on different days by panelists who were chosen at random from the NARADCOM volunteer consumer panel. Twenty panelists were selected to evaluate each of the four blends tested. Panelists evaluating the hamburger sandwiches were allowed to select and use the condiment they preferred: salad dressing, catsup, pickle relish, mustard, onion, tomato, lettuce, salt, and pepper. No condiments or gravy were allowed to be used by panel members when evaluating meat loaf samples.

C. Sensory Evaluation

The consumer test panel evaluated the hamburger sandwiches and meat loaf prepared with 10 and 20 percent levels of soy protein using a 9-point hedonic scale (1 - Dislike Extremely to 9 - Like Extremely) for overall acceptability. [3] Sample presentation was randomized. Panelists were served at timed intervals to reduce bias and insure independent judgments.

[3] Peryam, D.R. and F.J. Pilgram. 1957. Hedonic Scale Method of Measuring Food Preferences. Food Technol. II, Vol. No. 9, Supplement pages 9 - 14.

RESULTS AND DISCUSSION

Neither time in storage, up to 12 months at 0°F (-17.8°C), nor the composition of the ground beef soy protein concentrate blends had any apparent effect upon the sensory acceptability of the products tested (Table 2). Mean sensory scores for both the patty and bulk blends containing 10 and 20 percent added soy protein concentrate rated as high after 12 months storage as at the initiation of the test.

TABLE 2

Sensory Ratings of Ground Beef/Soy Protein Concentrate Blends Prepared as Meat Loaf and Patties (Hamburgers) at 3, 6, 9, and 12 Months Storage at 0°F (-17.8°C)

Blend	Time in Storage	Sensory Rating[a] 10% Soy Conc.		20% Soy Conc.		ANOVA[b]
	(mo.)	$\bar{X}$	S	$\bar{X}$	S	
Patty	3	7.1	c	7.5	c	c
	6	7.9	± 0.71	7.7	± 1.13	N.S.D.
	9	7.3	± 1.12	7.2	± 1.18	N.S.D.
	12	7.7	± 0.59	7.6	± 0.94	N.S.D.
Bulk	3	7.5	± 1.24	7.1	± 0.99	N.S.D.
	6	7.1	± 1.63	7.5	± 0.94	N.S.D.
	9	6.9	± 1.48	7.4	± 1.11	N.S.D.
	12	7.5	± 0.87	7.2	± 1.12	N.S.D.

a Means of 20 evaluations. A consumer test panel of 20 people judged product acceptability on a 9-point hedonic scale, scored from Dislike Extremely = 1 to Neither Like or Dislike = 5 to Like Extremely = 9

b N.S.D.: No significant difference between variables.

c Individual scores inadvertently destroyed prior to calculation of standard deviation.

An analysis of variance shows no significant statistical difference exists between the consumer acceptability of ground beef patty or bulk ground beef blends containing 10 or 20 percent hydrated soy protein concentrate when prepared and served under conditions of the test. In addition to the favorable statistical data, panel members made very favorable comments concerning product juiciness and texture. These comments are consistent with observations made by those preparing the products - that an appreciable reduction in cooking loss was experienced with the ground beef/soy protein concentrate blends.

CONCLUSION

This study shows that ground beef patty or bulk ground beef blends containing up to 20 percent hydrated granular soy protein concentrate, when prepared in accordance with typical Armed Forces Recipes, produce very acceptable finished products. The high acceptability rating for the blends was maintained over a 12-month storage period at 0°F (-17.8°C), demonstrating their good stability properties and indicating that they will be acceptable even under the rigorous conditions of the military distribution system. The use of ground beef soy protein blends can successfully assist the Department of Defense in reducing the amount and cost of beef procured by the Armed Forces without sacrificing quality, nutrition, and acceptability of the finished product.