Comparative Examination of Granulated Isolated Soy Protein and Textured Soy Flour in Formed Ground Meat Products.

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The results obtained by the examination of properties attributed to a new form of structured soy protein - granulated soy isolate, Purina Protein 220 - are described.

The use of granulated soy isolate as a substitute for a portion of meat was examined in four ground meat model-products : 'pljeskavica', patties, meat balls and meat loaves. Comparisons were made to an all-meat control and a third series of products containing textured soy flour (Purina Protein 50-2). Sensory properties and weight loss during heat treatment were measured.

Results indicated that the granulated soy isolate represents up to now the most perfect structured soy protein.

The addition of granulated soy isolate resulted in a decreased weight loss during heat treatment and improved sensory properties. Industrial application of granular isolate in ground meat products is technologically and economically justifiable for consumer products or for institutional feeding.

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Historically, a number of structured soy products have been available for use in coarse ground meat products. These products emerged due to the need for a soy ingredient similar to the texture of ground meat. Within the past 10 years, different procedures have been patented for the production of structured soy proteins which differ from each other in terms of nutritional value, composition, consistency and sensory properties. Many researchers throughout the world have described the technological, nutritive and economic limitations of various structured soy proteins (1, 2. 3.). The basic limiting factor affecting the use of larger quantities of textured flours and other soy proteins which contain oligosaccharides is the leguminous taste which they impart to fresh ready-to-eat products. Such a problem is particularly pronounced among those people who traditionally do not use soy in their diets. In most countries this problem is partially solved by applying specific spices as a means of improving taste.

New technology has made possible more advanced forms of structured soy proteins such as granular isolated soy protein called Purina Protein 220. Purina Protein 220 contains a minimum of 90% protein on a moisture-free basis, and all of the undesirable flavour components (oligosaccharides) have been removed.

The nutritive value of Purina Protein 220 has been confirmed in digestibility studies. In an experiment with pre-school children, age ranging from 2 to 4 years, it was determined that the digestibility of the granulated soy isolate amounts to 98.9% of milk protein when the same daily quantities were taken in (4).

These studies demonstrate that the nutritive value of Purina Protein 220 is sufficient to be used as a substitute for part of the lean meat in the manufacture of different types of meat products.

The objective of this study is to contrast these properties of classical textured soy flour and Purina Protein 220 when used as a replacer of lean meat in ground meat products.

MATERIALS AND METHODS

Granular isolated soy protein Purina Protein 220 and textured soy flour Purina Protein 50-2 were used.

The manufacturer of both proteins is Ralston Purina Company, U.S.A. The basic chemical composition of these products (protein content, water, fat, ash, pH) were determined according to AOAC methods.

For the purpose of examining the application possibilities of granular isolate and comparing its properties to those of textured flour, we selected the following products made from ground meat : pljeskavica, patties, meat loaves and meat balls. These products are important not only for the meat industry but for institutional feeding as well. All test products were made in a classical way. The control products were made of meat only, and the soy ingredients were introduced at the 3% and 5% levels (dry state). Textured flour was hydrated with 2 parts water at 6°C for 15 minutes. The granular isolate was hydrated with 3 parts water at 6°C for 40 minutes. Therefore, for each part of granular isolate added, 4 parts lean meat were removed. For each part soy flour added, 3 parts lean meat were removed. Meat replacement levels, calculated as a percentage of the meat block, are presented in table 1. The remaining ingredients in the formulas for each product category were standardized.

All meat was ground (5 mm plate), blended until homogenous, and shaped into different forms. 80 g samples of 'pljeskavica', having been stored in a refrigerator at 5°C for 24 hours, were heat treated on a grill for 5 minutes. Formed meat loaves, weighing 900 g, were cooked in a stove at 180°C for 1 hour. Meat balls, with a mass of 25 g, were prepared by frying in a fritter for 10 minutes. The patty, weighing 30 g, was fried in deep fat for 15 minutes.

Weight losses during heat treatment were determined by weighing the mass before and after heating. The percentage weight loss was calculated.

The sensory evaluation was carried out by eight trained panelists. The properties examined included consistency, flavour and juiciness.

Data were evaluated using an analysis of variance. Means were separated by the honestly significant differences (hsd) procedure (5).

RESULTS AND DISCUSSION

The chemical composition of the soy proteins is presented in table 2. The textured flour is characterized by a lower protein content and a large quantity of carbohydrate. Carbohydrates are absent from the granular isolate.

All of the meat products containing granular isolate had the most desirable sensory scores. Panelists evaluated the products containing granular isolate as very acceptable and palatable with a pronounced juiciness (table 3). Granular isolate was characterized by a thoroughly neutral flavour.

The meat products containing 5% granular isolate had sensory scores equivalent to their all meat counterparts and the products containing 3% textured flour, even though the 5% granular isolate products contained a substantially lower quantity of meat. The application of larger quantities of granular isolate did not result in leguminous flavour.

In the products containing 5% textured flour, there was a pronounced leguminous flavour. The results indicated that textured flour could not, in our trial conditions, be adequately applied at high levels of meat replacment.

The data presented in table 4 demonstrate that the lowest weight losses during heat treatment were observed in the products containing 5% Purina Protein 220. The products with 3% granular isolate registered lower weight losses during heat treatment than the control and the 3% and 5% textured flour products. The highest weight losses were observed in the control products.

In conclusion, granular isolate produced better results than the textured flour regarding the sensory properties of the meat loaf, 'pljeskavica', patties and meat balls. Granular isolate had a neutral flavour and did not create a leguminous flavour in the finished products at any of the replacement levels studied. Textured flour created an undesirable soy flavour at high levels of meat replacement. When hydrated, the granular isolate has a better texture and consistency than the textured flour and, as far as its properties are concerned, resembles to a higher degree the meat itself. Due to these properties, the granular isolate represents up to now the most perfect form of structured soy protein. Results demonstrated that the traditional quality of the meat products was maintained with granular isolate.

The products containing granular isolate also had lower weight losses upon heating than the products containing textured flour and the controls. Therefore, granular isolate is economically justifiable from the standpoint of net yield and ability to replace larger quantities of meat.

CONCLUSION

Under the conditions of this study, we arrive at the following conclusions :

1. Granular isolated soy protein Purina Protein 220 is a highly digestible protein which can successfully supplement animal proteins in the human diet while maintaining the composition of traditional ground meat products.

2. Granular isolate has a neutral flavour and does not impart leguminous soy flavour in finished ground meat products. Such a property makes it possible to use granular isolate at high levels as a substitute for meat.

3. Industrial application of Purina Protein in 'pljeskavica', patties, meat loaves and meat balls is thoroughly justifiable in economic and technological terms. This opens up great possibilities for the application of this new structured isolated soy protein in consumer products as well as in institutional feeding.

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TABLE 1

MEAT REPLACEMENT LEVELS
AS A PERCENTAGE OF
THE MEAT BLOCK

Meat Block	"Pljeskavica"					Meat loaves					Patties					Meat balls				
	K	A	B	C	D	K	A	B	C	D	K	A	B	C	D	K	A	B	C	D
Pork, (20% fat)	50	44,6	41,0	42,8	38,0	42,2	36,9	33,4	35,7	31,0	43,6	37,4	35,0	36,2	31,2	50	44,6	41,0	42,8	38,0
Young beef, (10% fat)	50	44,6	41,0	42,8	38,0	57,8	52,6	49,1	50,3	45,6	56,4	51,4	46,3	48,8	43,8	50	44,6	41,0	42,8	38,0
PP 50-2 (hydrated 1:2)	–	10,8	18,0	–	–	–	10,5	17,5	–	–	–	11,2	18,7	–	–	–	10,8	18,0	–	–
PP 220 (hydrated 1:3)	–	–	–	14,4	24,0	–	–	–	14,0	23,4	–	–	–	15,0	25,0	–	–	–	14,4	24,0

TABLE 2

CHEMICAL COMPOSITION

	Protein (Nx6,25 Moisture free basis),%	Moisture, %	Fat, %	Ash, %	pH	Carbohydrate %
Granulated Isolated soy protein (PP 220)	91.50	6.00	0.20	3.80	7.10	–
Textured soy flour (PP 50-2)	51.00	6.84	0.89	6.41	7.05	34.86

Table 3

GROUND MEAT PRODUCT SENSORY EVALUATION.

	Pljeskavica			Meat Loaves			Patties			Meat Balls		
	Consistency	Flavor	Juiciness	Consistency	Flavor	Juiciness	Consistency	Flavor	Juiciness	Consistency	Flavor	Juiciness
Control	4^a	3.9^a	3.3^c	4^a	2.5^c	3.1^b	4^a	3.1^{bc}	3.5^a	4^a	3.1^{bc}	3.4^a
3% PP 50-2	4^a	3.5^{ab}	4^a	4^a	3^{bc}	4^a	4^a	3.5^{ab}	4^a	4^a	3.5^{ab}	3.4^a
5% PP 50-2	4^a	3.1^b	3.5^{bc}	4^a	1.5^d	2.5^c	4^a	2.5^c	3.5^a	4^a	2.5^c	2.5^b
3% PP 220	4^a	4^a	4^a	4^a	4^a	4^a	4^a	4^a	4^a	4^a	4^a	4^a
5% PP 220	4^a	3.8^a	3.9^{ab}	4^a	3.5^{ab}	3.8^a	4^a	3.4^{ab}	3.9^a	4^a	3.5^{ab}	3.9^a

Values represent the mean of 8 replicates. Means within the same column bearing a common letter are not significantly different at the 95% confidence level.

Products were evaluated on the scale ranging from 1 to 4 : 1 = undesirable properties
2 = acceptable properties
3 = desirable properties
4 = highly desirable properties

TABLE 4

GROUND MEAT PRODUCT COOKING LOSS EVALUATION

	% Cooking Loss			
	"Pljeskavica"	Meat Loaves	Patties	Meat Balls
Control	22.2^a	33.2^a	20.4^a	22.8^a
3% PP 50-2	21.6^{ab}	30.6^{ab}	18.9^b	20.9^b
5% PP 50-2	20.8^b	30.0^{bc}	18.1^c	20.0^c
3% PP 220	19.4^c	27.8^{bc}	16.8^d	18.6^d
5% PP 220	18.9^c	27.0^c	16.2^d	18.1^d

Values represent the mean of 5 replicates. Means within the same column bearing a common letter are not significantly different at the 95% confidence level.