COMBINATION MEAT AND ISOLATED SOY PROTEIN PRODUCTS FOR WEIGHT AND SERUM CHOLESTEROL REDUCTION

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INTRODUCTION

Obesity and diet are strongly correlated with the high incidence of heart disease in developed countries (National Institutes of Health (NIH) 1985). Approximately 500,000 deaths occur in the United States annually from heart disease and 1.4 million in the Soviet Union (Chazov 1983). The primary dietary factors that have been correlated with heart disease are elevated fat intake, saturated fat, calories, and cholesterol (NIH 1985). These dietary factors, which usually result from a high consumption of animal products, have led to high blood cholesterol levels and the resulting high incidence of heart disease. The American Heart Association (Grundy et al. 1985) has reported that the typical adult American consumes between 40-50 percent of calories from fat, 16-18 percent from saturated fat, and 400-500 milligrams per day of cholesterol.

The NIH Consensus Conference on Obesity (1985) established that obesity itself was a health risk in addition to its contribution to heart disease, diabetes, and hypertension. Therefore, weight reduction to ideal body weight has been recommended, along with reduction of saturated fats and cholesterol, to reduce the incidence of heart disease and other health risks.

During weight loss, the energy content of the diet must be reduced while other nutrients are maintained at or above adequate intake levels to provide good health. Protein intake needs to be increased in order to prevent the loss of lean body mass (Bistrian et al. 1977).

A variety of food products that have acceptability comparable to traditional products is needed to allow consumers to meet these new dietary goals for extended periods. It is important that normal meal patterns be maintained for the long term control of body weight and the prevention of body weight cycling after weight loss. In order to be included in diets designed to reduce risk of obesity-related diseases, many meat products must be reformulated to reduce the content of energy, fat, and cholesterol. Decker et al. (1986) demonstrated that Isolated Soy Protein (ISP) could be used to replace part of the fat and lean meats in a frankfurter to achieve a 50% reduction in fat while maintaining the eating quality and shelf life of the product. Since ISP contains no cholesterol, replacement of part of the meat block results in a decrease in cholesterol content of the finished frankfurters. A high humidity cooking process was required to achieve appearance and texture similar to the standard frankfurter. The protein content of the finished product was increased fulfilling the requirement for a protein-sparing weight loss diet.

The objective of this research was to develop highly acceptable meat products which could be used for weight loss or weight maintenance by the US and USSR populations to aid in prevention of obesity and heart disease and to validate adequacy of reduced calorie menus using these foods.

EXPERIMENTAL METHODS

Meat Product Preparation

Formulas for low fat frankfurter and kolbasa (a slicing sausage) are presented in Table 1. They are similar to the optimised frankfurter formula developed by Decker et al. (1986). They are designed to produce eating quality comparable to traditional USSR sausages. The ISP was PP500E from Protein Technologies International, St. Louis, MO. USA.

The products were prepared in the pilot plant of the All-Union Meat Research and Design Institute. The emulsions were prepared in a bowl cutter using classical chopping procedures to a final emulsion temperature of 15°C. The frankfurters were stuffed into natural sheep casings and the kolbasa was stuffed into 65 millimetre fibrous casings.

Table 1. Formulas of Meat Products

	Frankfurter %	Kolbasa %
Lean Beef, 6% Fat	53.0	54.0
Pork backfat	15.0	16.0
Mechanically deboned beef	5.0	5.0
Isolated Soy Protein	4.5	5.0
Water	20.5	20.0
Nonfat Fat Dry Milk	2.0	--
Meat Block	100.0	100.0
Salt	2.2	2.7
Sodium Nitrite	0.01	0.01
Sodium Ascorbate	0.05	0.05
Sugar	0.12	0.10
Black Pepper	0.12	0.06
All Spice	0.08	0.06
Nutmeg	0.05	--
Fresh Garlic	--	0.12
Water	30.3	30.0
	132.63	133.12

Table 2. Composition of Diets

	Volunteers	Clinical Patients
Protein, g/day	89.3	92.2
Fat, g/day	70.2	38.7
Carbohydrate, g/day	170.0	148.2
Energy, Kcal/day	1729	1310

Table 3. Target Compositions of Products Containing ISP

	Total Protein %	ISP %	Fat %	Carbo-hydrate %	Energy Kcal/ 100g	Choles-terol mg/100g
Frankfurter	14.1	4.3	15.0	1.5	195	43
Kolbasa	13.2	4.1	15.0	0.5	188	42
Oat Porridge (dry)	23.7	10.6	6.8	57.4	390	0
Pasta (dry)	23.9	13.3	1.5	69.8	362	0
Beverage	3.3	3.3	2.4	5.0	55	0

Table 4. Results of Weight Loss Program

	Volunteers	Clinical Patients
Weight loss, kg	4.1	7.0
Serum Cholesterol		
Reduction, mmol/l	0.74*	2.73*
%	15.9	41.3
Serum triglycerides		
Reduction, mmol/l	0.02	0.89*
%	3.2	44.5

*P 0.05 vs initial value

The frankfurters were processed by a high humidity smoke and cook cycle, such as developed by Decker et al. (1986) to an internal temperature of 75°C. The kolbasa process was typical of large diameter sausage in the USSR, cooked to an internal temperature of 75°C.

Subjects

Two groups of subjects participated in the 30 day feeding study. One group, identified as "clinical patients", was recruited from the clinic of the Institute of Nutrition, Moscow. Another group, the "volunteer group" was recruited from the staff of the Institute of Nutrition, Moscow, and participated as outpatients. The clinical patients were all male and had a mean body weight of 103.6 ± 3.5 kg which was 44 ± 3.5% over ideal body weight (IBW). The clinical patients were all hypercholesterolemic individuals with mean serum cholesterol 6.616 ± 0.31 mmol/l. There were twelve women and two men participating in the volunteer group with a mean body weight of 76.2 ± 6.6 kg. These individuals averaged 24.8% above IBW and had mean blood serum cholesterols of 4.65 ± 0.27 mmol/l.

Diets

Diets were formulated to the compositions given in Table 2. The volunteer and clinical groups were given 1,700 KCal per day and were given 1,300 KCal per day, respectively. Typical meals served to both groups were as follows:

Breakfast: Nutritional Beverage, high protein oat porridge, fruit, tea or coffee

Lunch: High protein pasta with meat sauce, bread, low fat kolbasa, tea or coffee

Dinner: Low fat frankfurter, boiled potato, vegetables, cheese, tea or coffee

In addition to the low fat frankfurter and kolbasa, three other food products were formulated to include ISP as a major protein source. The target compositions of the products containing ISP are given in Table 3.

The oat porridge was dry blended from oats and ISP. The high protein pasta was prepared using commercial pasta making equipment and using enriched wheat flour and ISP (PP610). The nutritional beverage was prepared from ISP (PP620), corn oil, sucrose, vitamins and minerals to provide a nutritionally balanced drink supplying a minimum of 20% of the USRDA.

Measurements

Details of the measurements on the subjects were reported by Volgarev et al. (1988) and included daily weighing, blood pressure and pulse. Biochemical parameters were determined initially and at 14 and 30 days for the clinical patients and after 28 days for the volunteer group. An apparent nitrogen balance was determined on 8 patients in the clinical group at 6-8 days and at 28-30 days of the study.

RESULTS AND DISCUSSION

Patients and volunteers readily accepted the foods containing ISP with no complaints with respect to quality or quantity. No changes were observed in blood pressure, pulse, or gastrointestinal responses.

The results of the 30 day weight loss program are summarized in Table 4. The volunteers lost an average of 4.1 kg and the clinical patients lost 7.0 kg. The weight losses of the clinical patients are within the expected range of fat losses for males requiring 3,000 KCal per day and assuming a body fat calorie content of 7,800 KCal/kg. The weight losses of the volunteers are consistent with a 1,700 KCal intake and a requirement of 2,900 KCal/day for women weighing 76 kg. There were small, but statistically significant changes in some of the biochemical parameters but all the parameters were maintained within the normal ranges for adults. More detailed results have been reported by Volgarev et al. (1988).

The blood cholesterol levels of the volunteers decreased from a mean of 4.65 mmol/l to 3.91 mmol/l, a 15.9% reduction. This reduction is surprising since these individuals were primarily in the normal blood cholesterol range. The blood cholesterol values of the clinical patients decreased from an initial mean of 6.61 mmol/l to 3.88 mmol/l after 30 days on the dietary program. This cholesterol reduction was progressive over the 30 day period. This 41% reduction in serum cholesterol is similar to the results of Widhalm (1986) with hypercholesterolemic children and Verrillo et al (1985) with adult hypercholesterolemics from the addition of soy protein to the diet.

There were no significant change in the serum triglyceride levels in the volunteer patients, however, the clinical patients experienced a significant reduction of 0.89 mmol/l, 44.5%.

The clinical patients remained in mean positive apparent nitrogen balance of 2.8 ± 0.3 g/day based on 48 hour assays at 28-30 days. If an assumed allowance of 8 mgN/Kg/day for miscellaneous N losses is applied to the nitrogen balance, the estimated true nitrogen balance is still positive with an average additional nitrogen loss of 0.83 g/day. True protein digestibility was 97.7% during the nitrogen balance period.

These low fat, high soy protein containing foods appear to be appropriate for use in weight loss and weight maintenance diets for both hypercholesterolemic and normal cholesterolemic individuals. These foods are of particular value since they can be incorporated into a normal diet after the weight loss regime to aid the patient in maintaining ideal body weight.

CONCLUSION

Processed meat products have been developed for use in diets designed to correct overweight, reduce cholesterol intake, and reduce saturated fat intake to reduce the risk of heart disease and other diseases associated with dietary excesses. Low fat frankfurters and kolbasa were included with other food products containing ISP in 30 day weight loss diets fed to hospitalized clinical patients or moderately overweight outpatient volunteers. The diets resulted in the expected weight losses as well as 41% blood cholesterol reduction in the hypercholesterolemic patients and 16% reduction in the outpatient volunteers. These high protein foods maintained the subjects in positive nitrogen balance over the 4 week period of calorie restriction. It is hoped that these highly acceptable food products will provide the means to maintain significant weight loss and cholesterol reductions can be maintained over extended periods.

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