COLLAGEN AS A LEAN OR FAT MEAT REPLACEMENT IN PORK SAUSAGE

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Story in Brief

Collagen was used to replace various levels of either lean or fat meat (5, 10, 15 or 20 %) in pork sausage and stored at 0 C to determine the effect of collagen level and storage period on the quality characteristics of the sausage. Sensory evaluation indicated that products with collagen were indistinguishable from the control suggesting that collagen may be used as a suitable replacement for either the lean or fat tissue in pork sausage.

(Key words: Collagen, replacement, fat or lean.)

Introduction

Pork sausage is one of the more common meat items on the breakfast menu. In fiscal year 1983 alone, 1,114,663,000 pounds were prepared and processed under federal inspection. With such large volume of sausage products on the market, there has been a definite trend to develop products suitable fo use as extenders. Collagen is one such product that is under investigation.

Hydrolysates of beef or pork skin used to replace non-fat dry milk in cooked sausage formulation had greater water holding and fat holding ability. The higher protein content of the hydrolysate gave the sausage emulsion improved stability during cooking (Satterlee and Zachariah, 1973). The effect of food grade collagen substitution on the functional properties of coarse beef bologna by replacing lean meat at 10, 20 or 30 % levels indicated the potential of this ingredient (Schalk, 1981). Collagen also has been used in fine-emulsion bologna, replacing lean meat at 5, 10 or 15 % levels while keeping fat content constant at 25 % (Gielissen, 1981). The addition of wet collagen to ground beef at 0, 10 or 20 % levels as a lean meat replacement and the mixed products stored at -15 C for 2 weeks had no change in the eating quality characteristics (Chavez, 1983). Collagen has been used in various bakery products such as whole wheat muffins, sweet wheat loaf, corn meal muffins, plain cakes, carrot cake, oatmeal cookies and in plain and wheat bread spatzle (Ebro et al., 1979, 1980).

The purpose of this investigation was to determine the feasibility of substituting collagen for varying portions of the total lean tissue or the fat tissue of pork sausage.

Materials and Methods

Forty-five kg of raw pork shoulders and 10 kg of pork back fat were purchased from Ralph's Packing Co.(Perkins, Oklahoma) for the four replications in this experiment. After manually separating the fat tissue from the shoulders, the fat trim, lean trim and pork back fat were each

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ground separately once through a 1.27 cm plate into separate containers and sampled at random locations in their containers for fat determination by the modified Babcock method for cream (AOAC,1980).

Eight number 10 cans of food grade bovine hide collagen were used for this study. The calculated amounts of ground lean, ground fat and bovine hide collagen for each of the nine formulations (Table 1) were mixed with 61.6 g salt, 2.2 g sage, 4.4 g ground red pepper and 8.8 g ground black pepper using a Hobart paddle type mixer for 2 min.

Table 1. Pork sausage formulations.

Code	Tissue replaced	Level %	Lean g (1)	Fat g (2)	Collagen solid (3)	Collagen water (4)
C00	none	0	2776	1224	0	0
L05	lean	5	2576	1224	91	109
L10	lean	10	2376	1224	182	218
L15	lean	15	2176	1224	273	327
L20	lean	20	1976	1224	364	436
F05	fat	5	2776	1024	91	109
F10	fat	10	2776	824	182	218
F15	fat	15	2776	624	273	327
F20	fat	20	2776	424	364	436

(1) based on the 10 % average fat content of the 4 lots of lean tissue. (2) based on the 75.4 % average fat content of the 4 lots of fat tissue. (3) solid obtained from filtration. (4) aqueous portion obtained from filtration of collagen from the cans.

The resulting sausage mixture was ground once through a 0.64 cm grinder plate to provide uniform distribution of fat, lean and collagen. Supralon casings were filled with sausage using a mechanical stuffer to produce twelve 300 g chubs.

Triplicate samples from each formulation and the fibrous portion of the food grade collagen were used to determine the amount of moisture, protein and fat according to the AOAC methods (1980).The protein content of collagen was calculated as a percentage of nitrogen times 5.56 (Henrickson et al. 1984).

Twelve chubs prepared from each formulation were randomly assigned to 0, 2, 4 or 6 weeks of storage. At the end of each storage period, samples from each formulation were obtained for taste panel evaluation for color, juiciness, texture, flavor and overall acceptability of the cooked sausage using a semi trained laboratory panel. The panel used a descriptive scale, a modification of a score card, suggested by Stone et al.(1974), the modification being a line across each subjective trait, 14 cm long, with anchor points at 2cm interval. The left end point of the line was given a value of 0 with each succeeding anchor point assigned values in increments of 1 with the right end point having a value of 7. The vertical lines marked by each panelist on the score card were converted to numerical values using a template. Patties from each formulation were cooked on a pre-heated electric griddle set at 162.8 C and turned over every 5 min until each side had been cooked for a total of 10 min.

The results were analyzed statistically for analysis of variance and where differences were found the means were separated by Duncan's method.

Results and Discussion

Chemical Composition

The chemical composition of the collagen and the nine different pork sausage formulations are shown in Table 2. Collagen from all the four lots revealed similar percentages of fat, protein and moisture. The factor 5.56 was used to convert the percent nitrogen to percent protein in the collagen. Although the addition of collagen may affect the total protein in the pork sausage, the factor 6.25 was still used to calculate the percent protein. The amont of protein contributed by collagen, on a weight basis, is a small fraction of the total protein contributed by the other components of the sausage, i.e., the lean and fat tissue. Therfore any calculation involving a different factor for collagen would yield protein values that are slightly higher than the protein values of the control sausage.

The sausage formulations with replaced lean tissue possessed similar percentages of fat, protein and moisture. The percentage of fat decreased while the percentage of moisture increased when fat tisssue was replaced. The decrease in fat was attributed to the low fat content of collagen.

Table 2. Chemical composition of collagen and pork sausage.

Product	fat %	protein %	moisture %
Collagen	0.40	19.53	79.09
	0.31	18.00	79.15
	0.33	17.56	78.27
	0.31	19.97	78.80
C00	29.86	13.68	55.19
L05	30.02	13.34	55.18
L10	28.66	12.94	56.39
L15	29.56	12.49	56.59
L20	28.88	12.74	58.12
F05	27.44	13.87	56.61
F10	24.66	13.58	58.30
F15	20.29	14.60	63.90
F20	17.17	14.42	67.45

Sensory Evaluation

Sensory evaluation was conducted to determine if the taste panelists could discriminate any differences in the quality attributes of the pork sausage such as cooked color, juiciness, texture, flavor and overall acceptabilty. The semi-trained laboratory panelists found no significant differences in the quality attributes of the cooked pork sausage patties involving both types of replacement (Table 3.) except for the fat

Table 3. Effects of storage time and replacement of lean or fat meat with collagen on the mean values of sensory attributes(*) of pork sausage.

sensory trait	collagen level	Storage weeks 0	2	4	6
Color	C00	4.76	4.09	4.00	4.12
	L05	4.45	4.25	4.76	4.16
	L10	4.42	4.50	3.92	3.97
	L15	4.15	4.25	4.08	4.00
	L20	4.22	3.81	4.58	3.89
	F05	4.48	4.58	4.18	4.16
	F10	4.79	4.14	4.11	3.73
	F15	4.79	3.84	3.90	4.21
	F20	4.20	4.14	4.17	4.28
Juiciness	C00	4.40	3.75	3.40	3.17
	L05	4.15	3.87	4.18	3.56
	L10	3.97	3.84	3.79	3.71
	L20	4.18	3.95	4.25	3.44
	F05	4.22	3.54	3.59	3.18
	F10	4.11	4.18	3.74	3.34
	F15	3.98	3.43	3.11	3.04
	F20	3.96	3.54	3.89	3.43
Texture	C00	3.76	3.44	3.39	2.99
	L05	3.81	3.73	3.95	3.29
	L10	3.77	3.53	3.57	3.66
	L15	3.91	3.21	3.19	3.47
	L20	3.63	3.78	3.82	3.05
	F05	4.04	3.81	3.61	3.46
	F10	3.86	3.99	3.46	3.22
	F15	3.91	3.34	3.36	3.20
	F20	3.96	3.54	3.89	3.43
Flavor	C00	4.72	4.24	3.72	3.83
	L05	4.40	4.13	4.34	4.03
	L10	4.02	4.17	4.05	3.95
	L15	4.18	4.16	4.38	3.86
	L20	4.02	3.62	4.08	3.96
	F05	4.19	4.17	4.05	3.78
	F10	4.17	4.35	4.21	3.93
	F15	4.01	3.11	3.80	3.65
	F20	3.85	4.18	3.82	3.66
Over all acceptability	C00	4.76	3.97	3.74	3.40
	L05	4.45	3.98	4.39	3.80
	L10	4.02	4.26	4.01	4.04
	L15	4.16	3.87	4.22	3.54
	L20	4.08	3.49	4.14	3.63
	F05	4.30	3.97	3.74	3.40
	F10	4.47	4.53	3.72	3.86
	F15	4.25	3.02	3.61	3.53
	F20	3.92	3.88	3.77	3.29

* Values based on eight-point scales where 7 = very desirable color or very juicy or very fine or intense pork flavor or like moderately; 1 = very undesirable or very dry or very coarse or extremely off flavor or dislike moderately.

replaced patties at 15 % level which had a significantly lower taste panel score for flavor. This difference may primarily be attributed to differences among the panelists ($P< 0.05$). There were also no significant differences in these quality attributes due to storage periods of the fat tissue replaced sausages; no sinificant differences in the color and flavor due to storage. These sausages, however, were found to be less juicy ($P<0.05$) and less acceptable ($P<0.05$) at weeks 4 and 6 compared to week 0. The patties at week 6 also were found to have a less desirable ($P<0.05$) texture compared to patties at week 0.

Differences in the juiciness, flavor and overall acceptability of the cooked patties were probably not detected because of the differences among panelists. It is also possible that the spices used in the formulations may have shielded the effect that collagen may have had upon the juiciness and flavor of the patties.

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