

Chemical and Sensory Characteristics of Emulsion Goat Meat Sausages Containing Pork Fat or Shortening

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ABSTRACT

Lean goat meat was used to produce emulsion-type sausages using pork backfat or shortening at the levels of 20, 25, 30, 35 and 40%. There were significant differences ($P < 0.05$) in moisture, protein and fat contents. There were no significant differences for pH and salt contents of the sausages. Visual appearances including outer colour, inner colour and texture were significantly different ($P < 0.05$). Colour of the sausages with higher fat levels was lighter and texture was less firm while elasticity/springiness was lower ($P < 0.05$). The sausages had similar moist/juicy and oily/greasy characteristics ($P > 0.05$). There were no significant differences in goaty and porky flavour and overall desirability. Smoky and seasoning flavour were more intense with lower fat levels ($P < 0.05$). Consumer acceptability was significantly lower ($P < 0.05$) with 40% shortening sausage, whilst 35% pork backfat and 25% shortening sausages rated the highest.

INTRODUCTION

Goats have traditionally furnished man with milk, clothing and meat. Goat meat (cabrito and chevon) is one of the major sources of protein in many countries. Production and consumption of goat meat are greatest in the tropics and subtropics (Devendra and Owen, 1983). Goat meat production in Thailand is primarily found in villages of the southern region where the Thai Muslim population is relatively high (Saithannoo and Milton, 1988).

In general, very little goat meat is consumed and there has been only limited research on the qualities and utilisation of goat meat in processed products such as sausages and cured meats (Park and Washington, 1993; Lamikanra and Dupuy, 1990; Reddy, Terrell, Dutson, Smith and Savell, 1988). The low consumption of goat meat and its products may be associated with a dislike for its aroma and flavour or prejudice against its "goaty" odour. This chevon flavour is reported to be primarily associated with 4-methyloctanoic and 4-methylnonanoic acid (Cramer, 1983; Wong, Nixon and Johnson, 1975).

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To promote goat meat consumption and utilisation in Thailand, this experiment investigated the proximate composition, sensory qualities and consumer acceptability of emulsion-type goat meat sausages produced by incorporation of pork backfat or shortening in the formulations. It was expected that the shortening sausages could be consumed by Muslim people.

MATERIALS AND METHODS

Ingredients and Processing

Goat meat carcasses were obtained from the Department of Animal Science, Prince of Songkla University. Fresh goat meat was deboned and trimmed of separable fat to provide extra lean meat. The lean meat was frozen at -18°C until needed. Pork backfat was obtained from the local market and stored overnight at 4°C . Shortening (Silver Cloud, Lever Brothers Co., Ltd) was obtained from a local supermarket.

The day before production of the sausages, the frozen goat meat was thawed in a 4°C cold room. The lean meat and pork backfat were separately ground through a meat grinder (2 mm). Sausage batters were formulated using 3 kg goat meat and 1.2 kg crushed ice with different levels of pork backfat or shortening; 20, 25, 30, 35 and 40%. To each batch, seasoning of the following formula was added; 1.5% salt, 0.005% sodium nitrite, 0.3% black pepper, 0.1% nutmeg, 0.3% sugar, 0.2% monosodium glutamate and 0.3% phosphates.

The blends of meat and ingredients were chopped in a bowl chopper (Muller, Saarbrucken, W. Germany) to an endpoint temperature of 12°C . The emulsion batter was stuffed into 20 mm cellulose casing using a hydraulic stuffer and manually linked. The emulsion sausages were smoked in a smoke house at 65°C for 30 min, then at 70°C for 1 hr and cooked in the sausage cooker to 75°C for 20 min and soaked in running cold water for 15 min. After chilling in running water, the sausages were vacuum-packed in plastic bags and stored at 4°C for 2 days for subsequent analysis. The production of emulsion sausages was repeated once.

Chemical Analysis

Representative emulsion sausage samples from each

treatment were homogenised and analysed for moisture, protein, fat, pH and sodium chloride using A.O.A.C. (1990) procedures. All analyses were performed in duplicate.

Sensory Evaluation

The sensory analysis was performed using the quantitative descriptive analysis (QDA) method (Stone, Sidel, Oliver, Woolsey and Singleton, 1974). The sensory panel consisted of eight trained panellists. A continuous non-structured scale was used for evaluation. A 10 cm line anchored on the left side with the lowest intensity of each attribute and the right side with the highest intensity was used. Each marked point was converted into a numerical value from 0 to 100 according to its location. Training consisted of presenting cooked, minced goat meat, beef and pork and commercial emulsion-type sausages in three preliminary evaluation sessions. The panel members were recruited and selected from graduate students in the Department of Agro-Industry, Prince of Songkla University.

For evaluation of visual appearance, representative samples of emulsion sausages were longitudinally cut into halves. Outer and cut surfaces were evaluated for outer and inner colour and texture.

Mouthfeel (tenderness, elasticity/springiness, moistness/juiciness, oiliness/greasiness and coarseness) and flavour (goaty, porky, smoky and seasoning flavour) characteristics and desirability were evaluated by the same group of panellists using the QDA method. The emulsion sausages were randomly selected and coded. The sausages were cut into two segments and served in random order.

A consumer preference test was also performed for acceptability with 30 inexperienced panellists using a face scale (Stone and Sidel, 1993). The score sheet was decoded numerically, eg, 1 = dislike the most to 5 = like the most.

Statistical Analysis

The experiment was a randomised complete block design. Statistical analyses involved use of the IRRISTAT (1992). Analyses of variance were performed by ANOVA procedures. Significant differences between means were determined by Duncan's Multiple Range tests. For sensory data, the fat levels were the treatments and the panellists were the replications.

RESULTS AND DISCUSSION

Chemical composition

Chemical composition data (moisture, protein and fat), pH and salt content (as NaCl) of emulsion goat meat sausages are presented in Table 1. The chemical composition of the sausages supported previous research by Troutt, Hunt, Johnson, Claus, Kastner, Kropf and Stroda (1992) showing significant differences ($P < 0.05$) in the proximate composition of the sausages produced with different levels of both fat sources. As the fat levels increased, the moisture levels of the sausages decreased. Protein was higher ($P < 0.05$) in low fat sausages. Lower-fat sausages contained less ($P < 0.05$) fat than higher-fat formulations. There were no significant differences in pH and salt contents of the sausages. The salt contents of all sausages produced with pork backfat were higher than those

Table 1. Chemical composition of emulsion goat meat sausages

Fat Source/Level	Moisture (%)	Protein (%)	Fat (%)	pH	NaCl (%)
Pork fat					
20%	67.50 d ¹	15.98 f	11.25 a	6.45	2.20
25%	64.76 cd	15.07 ef	13.50 ab	6.45	2.25
30%	62.08 bc	14.14 de	15.75 bcd	6.50	2.19
35%	61.76 bc	12.90 cd	17.00 cde	6.50	2.22
40%	58.93 ab	12.43 c	21.50 f	6.50	2.01
Shortening					
20%	66.01 d	12.11 bc	14.50 bc	6.45	1.86
25%	63.73 cd	11.71 bc	17.50 de	6.45	1.87
30%	61.55 bc	11.75 bc	19.00 e	6.40	1.69
35%	59.71 b	10.87 ab	23.50 fg	6.40	1.68
40%	55.85 a	10.24 a	25.75 g	6.40	1.71

¹Means followed by a different letter were significantly different ($P < 0.05$)

of shortening sausages. This could be explained by the natural content of sodium and chlorine in pork backfat (Price and Schweigert, 1978).

Sensory evaluations

Sensory characteristics including visual appearance, texture by mouthfeel, flavour and desirability of emulsion goat meat sausages are presented in Tables 2, 3 and 4.

Increases in levels of both pork backfat and shortening affected ($P < 0.05$) the visual appearance of the sausages

Table 2. Mean scores for appearance of emulsion goat meat sausages evaluated by QDA

Fat Source/Level	Outer Colour	Inner Colour	Texture
Pork fat			
20%	65.56 d ¹	45.63 e	38.88 b
25%	56.25 cd	39.31 d	34.31 ab
30%	47.81 bc	33.13 c	33.75 ab
35%	49.25 bc	33.75 c	33.19 ab
40%	39.63 ab	27.19 ab	32.75 ab
Shortening			
20%	54.69 cd	45.13 e	29.69 a
25%	46.69 abc	32.63 bc	27.56 a
30%	38.29 ab	23.63 a	26.56 a
35%	35.06 a	25.13 a	26.38 a
40%	35.31 a	23.00 a	26.06 a

¹ Means followed by a different letter were significantly different ($P < 0.05$)

(Table 2). The outer and inner colour of the sausages were less intense as the fat levels increased. This could be the dilution effect of the higher fat content and less protein (Table 1) on the goat meat pigment in the sausage formula (Reddy *et al.*, 1988; Trout *et al.*, 1992; Bloukas and Paneras, 1993). With the same fat source, there were no significant differences in texture of the sausages. The 20% pork fat sausage was rated the highest score and significantly differed ($P < 0.05$) from the sausages made with shortening at all levels. The texture of all shortening sausages rated lower than the pork fat sausages. The higher the fat contents, the lower the texture scores. Increasing fat levels may produce sausages with looser textural appearance. A similar effect was reported by Trout *et al.* (1992) who found that as fat increased shear value decreased.

Mean scores of texture by mouthfeel are reported in Table 3. Tenderness scores were assigned from tender to tough on the lower end to the higher end, respectively on the QDA scale. Sensory evaluation showed significant differences ($P < 0.05$) in tenderness, elasticity/springiness and coarseness of the emulsion goat meat sausages. Lower fat levels produced tougher and more elastic emulsion sausages than did higher fat levels. Emulsion goat meat sausages containing pork backfat were firmer than those containing shortening fat. This may also affect the sense of coarseness for the panellists who found that higher fat levels gave finer and looser textured sausages. Having fat tissue residues, pork backfat obviously produced emulsion sausage with coarser and firmer texture. Bishop, Olson and Knipe (1993) similarly reported that bologna produced from intact pork fat was firmer than those from emulsified corn oil.

There were no significant differences between fat

Table 3. Mean scores for texture of emulsion goat meat sausages evaluated by QDA

Fat Source/Level	Tenderness	Elasticity/Springiness	Moistness/Juiciness	Oiliness/Greasiness	Coarseness
Pork fat					
20%	51.50 c ¹	66.56 e	40.88	40.06	38.69 c
25%	41.13 b	61.13 de	45.38	44.31	37.19 c
30%	33.50 b	51.56 cd	48.06	40.50	38.38 c
35%	34.88 b	51.00 bc	47.19	46.56	30.63 bc
40%	23.88 a	41.63 ab	53.88	49.13	29.38 abc
Shortening					
20%	34.06 b	51.81 cd	47.19	41.50	25.25 ab
25%	34.81 b	46.19 abc	46.63	43.19	23.63 ab
30%	24.31 a	37.00 a	42.88	45.69	22.63 ab
35%	21.81 a	40.31 a	45.13	43.50	19.13 a
40%	25.00 a	39.88 a	42.44	44.38	22.75 ab

¹ Means followed by a different letter were significantly different ($P < 0.05$)

Table 4. Mean scores for flavour and desirability of emulsion goat meat sausages evaluated by QDA

Fat Source/Level	Goaty	Porky	Smoky	Seasoning	Desirability
Pork fat					
20%	32.19	23.56	54.56 c ¹	41.88 c	62.94
25%	26.81	21.31	51.38 bc	42.13 c	60.31
30%	34.69	21.75	44.94 abc	39.94 bc	60.44
35%	30.25	20.06	47.94 abc	40.88 c	51.31
40%	31.38	18.88	40.63 a	39.06 bc	60.94
Shortening					
20%	33.63	16.00	46.13 abc	33.44 ab	66.25
25%	20.88	14.31	41.69 ab	33.44 ab	65.69
30%	28.13	16.31	39.81 a	31.38 a	58.56
35%	25.31	18.06	38.94 a	35.25 abc	60.44
40%	26.69	20.56	38.63 a	33.31 ab	57.31

¹ Means followed by a different letter were significantly different ($P < 0.05$)

sources and within fat levels in moistness/juiciness and oiliness/greasiness. However, higher fat levels tended to produce more oily/greasy and moist/juicy values than lower fat levels. Lee, Whiting and Jenkins (1987) reported the intensity of greasiness of frankfurters increased significantly with increased fat content.

Flavour characteristics

Mean scores for flavour and desirability are presented in Table 4. Emulsion goat meat sausages made with pork backfat, regardless of fat levels, were not different ($P > 0.05$) from sausages made with shortening fat in goaty and porky flavour. However, sausages made with pork backfat produced higher intensity of the two flavours than those made with shortening fat and all scores were at the lower end of the 100-point scale. Smoky and seasoning flavours differed ($P < 0.05$) with fat levels and fat sources. Regardless of fat sources, the higher the fat levels, the higher the intensity of smoky and seasoning flavours. This indicates that sausages with reduced fat content may allow smoke and spices to be perceived more readily (Bishop *et al.*, 1993).

There were no significant differences ($P > 0.05$) in desirability of the emulsion sausages. All desirability scores were at the higher end of the 100-point scale. The sausages with lower fat levels rated higher. This could be the preferences of panellists for less mealy and greasy sausages (Lee *et al.*, 1987).

Consumer preference test

Consumer preference test results for emulsion goat meat sausages made with pork backfat and shortening are presented in Table 5. The consumer acceptability differed ($P < 0.05$) among the shortening sausages but

Table 5. Mean consumer scores of emulsion goat meat sausages evaluated by facial hedonic scale¹

Fat Source/Level	Moisture (%)
Pork fat	
20%	3.53 abc ²
25%	3.55 abc
30%	3.82 bc
35%	3.88 c
40%	3.85 c
Shortening	
20%	3.73 bc
25%	3.77 bc
30%	3.57 abc
35%	3.47 ab
40%	3.23 a

¹ 5 = like the most, 1 = dislike the most

² Means followed by different letter were significantly different ($P < 0.05$)

did not differ among the pork fat sausages. The sausages with 40% shortening rated the lowest scores. With increasing fat levels, the pork fat sausages received higher scores but the shortening sausages received lower scores. This could be that higher levels of shortening gave sausages with less colour intensity and less elasticity/springiness (Tables 2 and 3). For each fat source, the 35% pork fat and the 25% shortening sausages rated the highest scores.

In summary, higher fat levels dilute the moisture and protein contents of the sausages resulting in less intensity of outer and inner colour, more tender, moist/juicy, oily/greasy, less firm and finer sausages.

Lower fat levels increased panel scores for smoke and seasoning. Regardless of fat sources and levels, goaty flavour was considered as low intensity in the sausages produced from either pork backfat or shortening. Desirability and consumer acceptability of sausages made with both fat sources were at the higher end of the QDA scale.

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