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Research Paper

Studies on the Processing and Shelf Life of Low - Fat Chevon Patties with Preservatives

Indumathi J., Moorthy P.R.S*., Sudhakara Reddy K., Jagadeesh Babu A.

Department of Livestock Products Technology, College of Veterinary Science, Tirupati.

ABSTRACT

Refrigerated storage (4 ± 1°C) of lowfat chevon patties prepared from the pre-blended ground chevon with 0.25 percent sodium alginate (SA) alone or in combination with 0.1% ascorbic acid (AA) or 0.25 percent citric acid (CA) indicated that SA+CA samples had a significant lower pH, microbial load and higher tenderness scores compared to the other samples. On the other hand, the SA + AA samples had a lower TBARS values compared to the other samples. Irrespective of the formulations, there was a significant increase in hardness, pH, TBARS values and SPC values with increase in storage period, but psychrophiles and yeasts and moulds could not be detected in any of the product through out the storage period. On the other hand, for all the formulations, no significant change was observed in moisture, protein and fat contents through out the storage period. Organoleptic evaluation revealed that, the storage had significantly ($p<0.05$) reduced the mean color, flavor juiciness, tenderness and overall acceptability scores of all the formulations of low-fat chevon patties from 0 to 20th day.

Key words: *Processing, shelf life, low-fat patties, chevon, preservatives.*

INTRODUCTION

Nutritional guidelines suggest that not more than 10% of calorific values should come from saturated fats for better health and wellbeing (WHO 1990). Due to increased concern about dietary fat there has been a great demand for low-fat meat products. But reduction in fat in comminuted meat products results in rubbery and dry textured products (Keeton 1994). Appropriate fat replacers and optimization of their concentration to produce low-fat meat products having better consumer acceptability and marketing needs to be developed. Hence in the present study Sodium Alginate (SA) a carbohydrate, which is a fat replacer and commonly used at 0.25 percent level in the preparation of low-fat chevon patties along with two different preservatives; 0.1 % ascoric acid (AA) and 0.25 % citric acid (CA) separately to study their effects on shelf life of low-fat chevon patties.

**Corresponding author, e-mail:*

Microbial growth and oxidative rancidity are the major problems causing quality deterioration in processed meat products. The use of spices with other food ingredients such as NaCl, sugar and organic acid might provide a synergistic effect in controlling microbial growth (Giese 1994). The use of antioxidants like vitamin-C and E had a significant effect in reducing oxidation of lipids and pigments of meat during storage (Okayama *et al.*, 1987, Mitsumoto *et al.*, 1991). The AA has been widely used as a singlet oxygen quencher and reducing agent to control the activity of pro- oxidant metals (Ke, 2006).

MATERIALS AND METHODS

Chevon produced from adult male goat was purchased from the local market. The chevon was hot deboned after trimming of fat, connective tissue and then cut into small cubes. The deboned meat was initially minced in meat mincer (Sirman TC 12E) through a 13 mm diameter plate followed by a 4 mm diameter plate to obtain fine meat mince. The minced chevon thus prepared was used in different experimental trials. The spice mixture, condiments and other additives were purchased

from local market. Ascorbic acid was purchased from Finar Cheimals Limited and Citric acid from Qualigens Fine Chemicals, Mumbai.

The formulation of three low-fat batches (0.25 percent SA, 0.25 percent SA + 0.1 perent AA and 0.25 SA + 0.25 percent CA) and control with 20 percent vegetable fat were standardized by preliminary trials (Table 1). All the ingredients and minced meat as per table 1 were thoroughly mixed by a mincer for 1 min. For all the batches 15 percent level corn floor was added as binder. Chilled water was added at 5 percent to the low-fat batches. Then the meat dough of all four batches prepared was formed into circular patties using petriplates of dimensions 5 cm and 1.5 cm thickness. The moulded patties were oven cooked at 180°C for 25 minutes to attain an internal temperature of 75 ± 1°C. The patties were turned upside down twice at 5 minute intervals for better color and texture. All the four batches after processing were aerobically packed in LDPE and were evaluated for keeping quality under refrigeration temperature (4 ± 1°C) at 4 days interval (0, 4, 8, 12, 16, 20) for 20 days. The prepared patties were analyzed for physic-chemical, proximate, microbiological and organoleptic characteristics.

The hardness of the patties was measured in terms of penetration value with the help of cone penetrometer as described by Dixon and Parech (1979). The pH of the patties was determined by following the procedure of Jay (1964). The 2-Thiobarbituric acid reactive substance value (2-TBARS) of the sample was determined by following the procedure of Tarladgis *et al.,* (1960). The percent moisture, crude protein and crude fat were estimated as per AOAC (1994). The mesophilic, psychrophilic and the yeast and mould counts per gram of low-fat chevon patties at refrigerated temperature were estimated as per the technique recommended by Chestnut *et al.,* (1997). The patties were warmed in oven for 1 minute and subjected to sensory evaluation on a 9 point hedonic scale by a semi trained five members taste panel at the department of Livestock Product Technology, C.V.Sc., Tirupati. The data obtained in the present study was analysed statistically as per the methods outlined by Snedecor and Chochran (1980).

RESULTS AND DISCUSSION

All the low-fat batches recorded significantly ($P<0.05$) higher penetration values (High penetration value corresponds to lower hardness of patties) compared to the control and no significant difference was observed between three low-fat batches. The hardness of all the formulations increased gradually during the storage period (Table 2) though it was not significant upto 16th day. This might be due to gradual loss of moisture during refrigerated storage (4 ± 1°C). Clarke *et al.,* (1988) in restructured beef, Yang *et al.,* (2007) in low-fat pork sausages, Kumar and Shaoo (2006) in low-fat chevon loaves also reported similar results.

Table 1: Formulations of control and low-fat chevon patties incorporated with preservatives

Ingredients(gm)	Control patties	Low Fat Patties		
		0.25% S.A Alone	0.25% S.A+ 0.1% Ascorbic acid	0.25% S.A + 0.25% Citric acid
Chevon	59.5	74.25	74.15	74
Vegetable fat	20	-	- -	
Corn flour	15	15	15	15
Salt	1.5	1.5	1.5	1.5
Spice mix	2.4	2.4	2.4	2.4
Onion garlic paste	1.6	1.6	1.6	1.6
Chilled water	-	5	5 5	
Sodium alginate	-	0.25	0.25	0.25
Ascorbic acid	-	-	0.1	-
Citric acid	-	- -	0.25	
Total	100	100	100	100

The mean pH values (5.93-6.32) differed significantly (P<0.05) during storage period (4 ± 1°C). Significantly (P<0.05) lowest pH values were observed in 0.25% SA + 0.25% CA incorporated patties compared to the rest of the batches (Table 3). Similar results were obtained in cooked ground turkey (Sammel and Claus et al., 2001), beef (Silva, 1999). A significant increase in mean pH was observed as storage period advanced. This might be due to concomitant increase in bacterial load which release metabolites during their metabolism and cause deamination of proteins (Jay 1996). This increase in pH also due to higher degree of oxidation and loss of free acidic groups of meat proteins upon cooking (Lawrie 1998). These findings were correlated with Manish Kumar and Sharma (2004) in low-fat ground pork patties and Devatkal and Mendiratta (2001) in restructured pork rolls.

A significant (P<0.05) increase (Table 2) of TBARS values was observed during storage all formulations. Among low-fat formulations significantly (P<0.05) lower TBARS value (0.89) were noticed in patties incorporated with 0.25% SA + 0.1% AA, compared to controls (1.37) which might be due to antioxidative effect of ascorbic acid . This might be due to higher fat content responsible for more oxidation in control. These finding were in agreement with Biswas *et al.*, (2006) chicken patties. Manish Kumar and Sharma (2004) in low-fat ground beef, Jo *et al.*, (1999) in pork sausages, Lee *et al.*, (2007) in chicken patties and Okayama (1987) in beef streaks.

The overall means of percent moisture, percent protein and percent fat of low-fat chevon patties of selected formulations did not differ significantly (P>0.05) by different formulations and storage periods (4 ± 1°C). But all the low-fat formulations significantly (P<0.05) differed from the control. (Table 3). Similarly Nadia and Haja (2008) in chicken meat, Antony *et al.*, (2006) in Turkey Rools and Dharmareer *et al.*, (2007) in smoked chevon sausages also found correlated findings.

Table 2: Hardness, pH, 2-TBARS values of low-fat chevon patties during storage at 4±1°C (Mean ± SE)

Day No	Control	0.25% SA	0.25% SA +0.1% AA	0.25% SA +0.25% CA	Overall mean
Hardness					
0	46.50±0.64	74.15±0.29	75.50±0.29	75.75±0.322	67.82±3.28^{a}
4	45.50±0.29	73.25±0.25	74.25±0.48	77.00±0.41	67.50±3.39^{a}
8	44.75±0.48	67.62±0.24	69.00±0.41	78.75±0.25	65.03±3.32^{a}
12	43.00±0.71	61.5±0.20	63.75±0.25	80.00±0.41	62.06±3.39^{a}
16	41.25±0.85	59.75±0.32	58.50±0.29	77.75±0.32	59.31±3.40^{ab}
20	39.50±0.86	56.62±0.24	56.63±0.24	77.75±0.32	57.18±3.38^{b}
Overall mean	43.42±0.56^{X}	65.48±1.36^{Y}	66.27±1.52^{Y}	77.54±0.47^{Y}	
pH					
0	6.13±0.007	6.12±0.004	6.02±0.006	5.46±0.008	5.93±0.071^{a}
4	6.19±0.006	6.22±0.004	6.09±0.007	5.52±0.040	6.01±0.073^{a}
8	6.23±0.009	6.27±0.004	6.15±0.004	5.66±0.015	6.08±0.063^{a}
12	6.29±0.004	6.34±0.008	6.25±0.005	5.69±0.008	6.14±0.068^{a}
16	6.34±0.006	6.40±0.006	6.38±0.005	6.19±0.009	6.22±0.072^{a}
20	6.52±0.004	6.49±0.004	6.41±0.017	5.81±0.014	6.31±0.075^{b}
Overall mean	6.28±0.026^{X}	6.31±0.025^{X}	6.22±0.029^{X}	5.64±0.025^{Y}	
2-TBARS					
0	0.78±0.003	0.74±0.005	0.65±0.005	0.71±0.005	0.72±0.012^{a}
4	0.83 ±0.008	0.79±0.003	0.69±0.006	0.76±0.003	0.77±0.013^{a}
8	1.12±0.005	0.90±0.004	0.74±0.009	0.84±0.003	0.90±0.036^{a}
12	1.45±0.003	1.12±0.004	0.92±0.005	0.99±0.006	1.12±0.052^{ab}
16	1.89±0.005	1.39±0.005	1.09±0.005	1.21±0.006	1.39±0.083^{ab}
20	2.14±0.005	1.78±0.005	1.29±0.006	1.44±0.005	1.66±0.084^{b}

Note: Mean values bearing at least one common superscript do not differ significantly

The mean SPC (standard plate counts) values increased significantly ($p<0.05$) as storage period increased irrespective of type of formulations (Table-3). This might be due to the permissive temperature and relative availability of moisture and nutrients for the growth of mesophilic bacteria. Similar results were obtained Naveen *et al.,* (2007) in microwave cooked chicken patties, Sahoo et al., (2002) in minced chicken meat and Verma an Sahoo (2000) in chevon sausages. Among the low-fat formulations, CA incorporated patties had significantly ($P<0.005$) lower microbial load. Rhee et al., (1997) in raw ground beef muscle also reported similar observation. But there is no significant difference in microbial loads of AA incorporated patties. Okayama et al., (1987) also reported that the viable bacterial counts were not affected by AA treatment in beef streaks. Irrespective of the type of formulations, growth of psychrophilies and yeast and Moulds could not be detected in all the formulations during refrigerated ($4 \pm 1°C$) storage for a period of 20 days this might be due to the temperature variance, unfavourable humidity, moisture conditions for their growth during storage. Biswas et al., (2004) in pre cooked pork patties, Manish Kumar and Sharma (2004) in low fat park patties. Nagamallika *et al.,* (2006) in spent chicken patties and Prabhakara Reddy and Janardhana Rao (2000) in chicken meat loaves also found the similar results.

Table 3: Moisture (%), protein (%), fat (%) and SPC (log CFU/g) values of low-fat chevon patties during storage at 4±1°C (Mean ± SE)

Day No	Control	0.25% SA	0.25% SA +0.1% AA	0.25% SA +0.25% CA	Overall mean
Moisture (%)					
0	47.72±0.056	1.89±0.04	61.89±0.04	61.90±0.04	58.35±1.58^{a}
4	47.71±0.056	1.88±0.07	61.89±0.05	61.89±0.05	58.34±1.58^{a}
8	47.70±0.056	1.87±0.04	61.88±0.05	61.88±0.03	58.33±1.59^{a}
12	47.69±0.056	1.87±0.04	61.87±0.05	61.87±0.04	58.33±1.58^{a}
16	47.68±0.076	1.86±0.04	61.86±0.06	61.87±0.03	58.32±1.58^{a}
20	47.69±0.076	1.84±0.05	61.87±0.05	61.86±0.04	58.31±1.58^{a}
Overall mean	47.70±0.02^{X}	61.87±0.02^{Y}	61.87±0.02^{Y}	61.88±0.01^{Y}	
Protein (%)					
0	14.07±0.021	7.61±0.07	17.60±0.06	17.61±0.07	16.72±0.39^{a}
4	14.11±0.041	7.61±0.06	17.61±0.06	17.61±0.07	16.74±0.39^{a}
8	14.13±0.061	7.62±0.05	17.61±0.07	17.62±0.06	16.74±0.39^{a}
12	14.14±0.061	7.62±0.05	17.62±0.09	17.62±0.07	16.75±0.39^{a}
16	14.14±0.071	7.62±0.06	17.63±0.06	17.63±0.06	16.76±0.39^{a}
20	14.16±0.081	7.65±0.05	17.64±0.08	17.64±0.08	16.76±0.39^{a}
Overall mean	14.13±0.02^{X}	17.62±0.02^{Y}	17.62±0.02^{Y}	17.62±0.02^{Y}	
Fat (%)					
0	22.68±0.07	4.91±0.05	4.91±0.05	4.92±0.53	9.35±2.20^{a}
4	22.67±0.06	4.91±0.04	4.90±0.05	4.90±0.05	9.34±2.22^{a}
8	22.66±0.07	4.90±0.05	4.89±0.05	4.89±0.04	9.33±2.22^{a}
12	22.65±0.08	4.89±0.05	4.89±0.05	4.89±0.04	9.33±2.22^{a}
16	22.62±0.06	4.87±0.04	4.89±0.06	4.88±0.05	9.31±2.21^{a}
20	22.61±0.07	4.86±0.05	4.89±0.04	4.87±0.04	9.30±2.21^{a}
Overall mean	22.65±0.02^{X}	4.89±0.02^{Y}	4.88±0.02^{Y}	4.89±0.02^{Y}	
SPC (log CFU/g)					
0	3.40±0.010	3.39±0.007	3.33±0.013	3.32±0.008	3.36±0.010^{a}
4	3.91±0.008	3.92±0.003	3.92±0.006	3.62±0.012	3.84±0.034^{b}
8	4.00±0.007	4.01±0.013	3.99±0.005	3.74±0.006	3.93±0.029^{c}
12	4.14±0.004	4.13±0.007	4.12±0.007	3.86±0.008	4.06±0.029^{d}
16	4.24±0.013	4.22±0.005	4.22±0.005	3.96±0.011	4.16±0.030^{e}
20	4.34±0.002	4.33±0.008	4.31±0.004	4.11±0.005	4.27±0.024^{f}
Overall mean	4.01±0.063^{X}	4.00±0.063^{X}	3.98±0.067^{X}	3.77±0.053^{Y}	

The changes in the sensory attributes of chevon patties during refrigerated storage are presented in Table 4. As storage period advances, the scores of sensory attributes (flavor, juiciness, tenderness, overall acceptability) were significantly decreased. No significant difference was observed for appearance between formulation and storage periods (4±1°C). Irrespective of the type of formulations, the mean scores decreased with increase in storage period though it was not significant. This might be due to myoglobin and lipid oxidation. These findings were correlated with Nath et al., (1995) in chicken meat patties, Manish Kumar and Sharma (2004) in chevon sausages, Rajnish *et al.,* (2008) in spenhen meat patties, Sahoo and Anjaneyulu (1997b) in buffalo meat nuggets. Significant decrease in flavor scores might be due to the off flavors caused by fat oxidation during storage. This decline in flavor scores was relatively higher in control than in low-fat samples and off flavors were detected in control on 20th day of storage. Gupta *et al* (1993) in mutton sausages, Nath *et al.* (1995) in chicken patties. Nadia and Hajo (2008) in chicken meat. Manish Kumar and Sharma (2004) in low-fat ground pork patties, Kalaikannan *et al.* (2007) in chicken patties observed similar findings. The mean values of juiciness did not differ significantly between the three low-fat batches patties incorporated with 0.25 SA alone scored higher

Table 4 : Organoleptic quality of low-fat chevon patties during storage at 4±1°C (Mean ± SE)

Day No	Control	0.25% SA	0.25% SA +0.1% AA	0.25% SA +0.25% CA	Overall mean
Colour					
0	7.10±0.16	7.05±0.15	7.15±0.19	7.05±0.13	7.08±0.07^{a}
4	7.05±0.15	7.00±0.17	7.10±0.16	7.00±0.12	7.05±0.08^{a}
8	7.00±0.16	6.95±0.16	7.10±0.17	6.95±0.17	7.00±0.07^{ac}
12	6.90±0.15	6.90±0.17	7.05±0.18	6.90±0.17	6.90±0.08^{ac}
16	6.80±0.13	6.80±0.17	6.90±0.19	6.90±0.16	6.85±0.08^{ac}
20	*	6.65±0.17	6.85±0.16	6.80±0.18	6.77±0.09^{c}
Overall mean	6.97±0.07^{X}	6.89±0.06^{X}	7.03±0.06^{X}	6.93±0.07^{X}	
Flavour					
0	7.55±0.19	7.70±0.16	7.50±0.21	7.65±0.22	7.60±0.07^{a}
4	7.35±0.13	7.65±0.15	7.45±0.16	7.50±0.19	7.48±0.07^{ab}
8	7.20±0.17	7.40±0.19	7.25±0.23	7.45±0.20	7.32±0.07^{bd}
12	6.90±0.14	7.20±0.16	7.20±0.17	7.30±0.16	7.15±0.09^{d}
16	5.80±0.17	7.05±0.22	6.95±0.16	7.00±0.20	6.70±0.09^{e}
20	*	6.80±0.16	6.75±0.17	6.95±0.17	6.83±0.09^{e}
Overall mean	6.96±0.09^{X}	7.30±0.07^{Y}	7.18±0.06^{Y}	7.31±0.06^{Y}	
Juiciness					
0	7.35±0.19	7.70±0.16	7.60±0.21	7.50±0.22	7.53±0.08^{a}
4	7.20±0.13	7.60±0.15	7.40±0.16	7.40±0.19	7.40±0.08^{ab}
8	7.00±0.17	7.40±0.19	7.30±0.23	7.30±0.20	7.25±0.08^{bd}
12	6.70±0.14	7.15±0.16	7.10±0.17	7.25±0.16	7.05±0.08^{d}
16	6.10±0.17	7.10±0.22	6.85±0.16	7.10±0.20	6.78±0.09^{e}
20	*	6.75±0.16	6.65±0.17	6.80±0.17	6.74±0.09^{e}
Overall mean	6.82±0.08^{X}	7.28±0.07^{Y}	7.15±0.06^{Y}	7.23±0.06^{Y}	
Tenderness					
0	6.90±0.17	7.60±0.18	7.50±0.21	7.75±0.17	7.43±0.07^{a}
4	6.80±0.11	7.50±0.18	7.45±0.15	7.70±0.16	7.36±0.09^{ab}
8	6.50±0.21	7.35±0.22	7.25±0.16	7.60±0.19	7.17±0.08^{bd}
12	6.35±0.16	7.10±0.20	7.20±0.17	7.45±0.17	7.02±0.08^{d}
16	6.10±0.17	6.80±0.15	6.95±0.44	7.15±0.16	6.75±0.09^{c}
20	*	6.30±0.16	6.75±0.17	6.90±0.14	6.65±0.09^{c}
Overall mean	6.53±0.07^{X}	7.11±0.07^{Y}	7.18±0.07^{Y}	7.42±0.06^{Z}	
Overall acceptability					
0	7.40±0.18	7.50±0.13	7.65±0.19	7.65±0.18	7.55±0.07^{a}
4	7.30±0.14	7.40±0.22	7.60±0.17	7.40±0.21	7.42±0.07^{ab}
8	7.05±0.15	7.25±0.20	7.45±0.19	7.35±0.22	7.27±0.07^{bd}
12	6.75±0.21	7.05±0.17	7.30±0.18	7.25±0.91	7.08±0.08^{cd}
16	6.15±0.16	6.65±0.16	7.05±0.15	7.00±0.19	6.71±0.09^{cd}
20	*	6.20±0.18	6.85±0.16	6.90±.020	6.65±0.08^{c}
Overall mean	6.93±0.09^{X}	7.01±0.07^{X}	7.32±0.07^{Y}	7.25±0.06^{Y}	

Note: Mean values bearing at least one common superscript do not differ significantly.
***** Product detected with off-odour, slimeness, hence not subjected to sensory evaluation.

juiciness scores throughout the storage period. The present findings were similar to Verma and Sahoo (2000) in chevon sausages, Manish Kumar and Sharma (2004) in low-fat ground pork patties, Prabhakara Reddy and Srinivasa Rao (1996) in chicken meat patties. CA incorporated patties registered highest mean tenderness scores throughout the storage period.This might be due to acids hydrolyze the meat proteins specially in myofibrillar proteins which cause the meat to be tender(Tahir 1983) Nadia and Hajo (2008) in chicken meat found similar results.

CONCLUSION

The low fat chevon patties prepared under this study were acceptable sensorily and microbio logically upto 20 days at refrigerated (4±1°C) storage unlike control which are acceptable only upto16 days of storage. However, patties incorporated with 0.25% SA+ 0.25% CA considered to be superior in respect to its quality characteristics that have lower lipid oxidation and microbial counts and better sensory attributes compared to the rest of the formulations.

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