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Quality and Storage Stability of Low Acid Goat Meat Pickle

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Abstract: The objective of this study was to prepare highly acceptable and long shelf-life low acid goat meat pickle and its quality evaluation and storage stability at $32\pm 0.5^{\circ}\text{C}$. Low acid goat meat pickle was prepared using deboned meat from spent *Barbari* goat breed. The product was evaluated after an elapse of seven days as maturation, for changes in physico-chemical (pH, titrable acidity), microbiological (Aerobic mesophilic, halophiles, yeast and mould counts) and organoleptic properties at an interval of 15 days up to 60 days of storage at $32\pm 0.5^{\circ}\text{C}$. Results showed that pH and titrable acidity of the low acid pickles was 4.87 and 0.69 whereas in control goat meat pickle, these values were 4.70 and 0.76, respectively after 60 days storage period. Microbiological counts and sensory quality traits did not show appreciable change and remained satisfactory throughout the storage period. Low acid pickles had significantly lower sourness and higher overall acceptability compared to the control. Therefore, the present study suggests that a highly acceptable low acid goat meat pickle can be prepared using spent goat meat and can safely be stored on shelf for 60 days even during summer season.

Key words: Goat meat pickle, low acid, quality, storage stability

INTRODUCTION

High perishability of meat and meat products is serious problem in India due to climatic conditions. Presently, emphasis is being given on developing shelf stable meat products, which can be stored at ambient temperature. Based upon various preservation techniques importance of shelf stable meat products like, cured and canned meat products, snack type meat products, meat pickles, intermediate moisture meat products etc. has been reported. Meat pickling in vinegar or edible oil with added salt, spices and condiments provide ready to eat, highly acceptable convenience meat product with good shelf stability at ambient temperature (Padda and Sharma, 1982; Sen and Karim, 2003). Low moisture and reduced pH are the two major factors contributing to shelf stability of the pickles. Pickling also helps in improving desirable characteristics like taste and flavor along with preservative effect. The preliminary trials and evaluation of market meat pickles has indicated that in the pH range of 4.4-4.7, the products were objectionably sour; consequently its acceptability was decreased. There is paucity of information on development and storage stability of low acid goat meat pickles and use of spent goat meat for preparation of pickles is limited. Moreover, meat pickles have the potential of becoming a ready-to-eat, highly acceptable, convenience meat product of indigenous origin. Therefore, the objective of the present study was to prepare highly acceptable goat meat pickle and study of their storage stability at $32\pm 0.5^{\circ}\text{C}$.

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MATERIALS AND METHODS

This study was conducted in Goat Products Technology Laboratory of Central Institute for Research on Goats, India during April to June (summer season) when the average temperature was in the range of 32-35°C.

Source of Meat

Around 3 years old Male *Barbari* goats were slaughtered hygienically in the institute and deboned meat chunks were stored at -20°C till further use for the pickle preparation. Frozen meat chunks were allowed to thaw for 15 to 20 h at 4±1°C and then cut into pieces of about 2-3 cm² at the time of use.

Goat Meat Pickle Preparation

Goat meat pickle was prepared as per the formulation reported by Pal and Agnihotri (1994) in 5 kg batches using 4% salt, 4% dry spice mix, 10% condiment mix (green curry stuff), 25% mustard oil, 1% acetic acid and 0.15% citric acid. This was considered as control whereas in case of low acid goat meat pickle no citric acid and only 0.85% acetic acid was used. Briefly, the meat pieces were pre-salted with 200 g salt (4%) and mixed proper for uniform dispersion. After pre-salting of meat pieces, 1500 mL potable water was added to it and pressure cooked for 20 min. The cook-out broth was separated from meat and its volume was adjusted to 2000 mL as and when required. Cooked meat pieces were deep fat fried in heated mustard oil till slight golden brown colour appeared. Dry spice mix and green curry stuff were fried in the remaining mustard oil and broth was then added and heated with constant stirring till boiling started. The composition of dry spice mix and condiment mix is presented in Table 1. Fried meat was added to it and allowed to boil for 2 min. The pickles were allowed to cool on their own. Thereafter, required quantity of acid was added and mixed thoroughly. After cooling, pickles were packed in the polyethylene terephthalate (PET) 500 g bottles and stored at 32±0.5°C.

Analysis of Samples

After 7 days as maturation period, changes in physico-chemical, microbiological and organoleptic properties were monitored at an interval of 15 days up to 60 days. The pH of the pickle was determined using combined electrode of a digital pH meter. The procedure outlined by Fisher and Peters (1968) was used for titrable acidity (% acetic acid) estimation. Total plate count, halophilic count and yeast and mold count in the samples were determined by the method described by APHA (1984). A 10 g sample was ground in a sterile pestle and mortar with 90 mL sterile 0.1% peptone water. Appropriate dilutions of samples were prepared in sterile 0.1% peptone water and plated in duplicate. The incubation time and temperature plates was 35±2°C for 24 h for total plate whereas the plates were incubated at 25°C for 5 days for yeast and mould count. Three similar trials were conducted and results were analysis using analysis of variance followed by Duncan's Multiple Range Test (Snedecor and Cochran, 1995).

Table 1: Composition of dry spice and condiment mix used in pickle preparation

Dry spice mix		Condiment mix	
Ingredients	Used in pickle (%)	Ingredients	Used in pickle (%)
Cumin seed	20.0	Onion	68
Coriander powder	20.0	Garlic	16
Black pepper	15.0	Ginger	16
Red pepper	12.5		
Turmeric powder	10.0		
Aniseed powder	7.5		
Cardamom	0.5		
Cinnamon	0.5		
Cloves	0.5		

Sensory Evaluation of the Pickles

A seven member sensory panel of the Institute scientists evaluated the sensory attributes viz., appearance, flavour, juiciness, texture, sourness and overall acceptability of the pickles using 8 point descriptive hedonic scale, where 8 denoted extremely desirable and 1 denoted extremely poor.

RESULTS AND DISCUSSION

Results showed that after a maturation period of 7 days, the pH and titrable acidity of low acid goat meat pickles were significantly ($p < 0.05$) different from standard meat pickles (control). There was slight increase in pH of 4.67 to 4.73 in control and 4.84 to 4.91 in low acid goat meat pickles in 60 days storage period. Similar patterns of change in pH of various meat pickles have been reported earlier (Padda and Sharma, 1982; Pal, 1990; Pal and Agnihotri, 1994; Shukla and Srivastava, 1999). The pH of pickles did not statistically show any appreciable changes throughout the storage period (Table 2) and were well below the pH value of 5.0, which is considered to be critical for storage stability of pickled meat products (Dziezak, 1986). The overall mean titrable acidity of control and low acid goat meat pickles were reported to be 0.763 to 0.696, respectively. This difference was due to initial concentration of acetic acid used. There was significant difference in titrable acidity between control and low acid pickle and at different storage intervals. Titrable acidity in low acid pickle was unaffected up to 45 days and thereafter it increased significantly ($p < 0.05$). Results were not in accordance with Shukla and Srivastava (1999) and Pal (1990) who reported that titrable acidity of pickle was unaffected by storage intervals. The increased titrable acidity could be due to more loss of moisture, which in turn could have increased concentration of undissociated molecules of acetic acid as in the present study, samples were drawn from the same bottle over the entire period of study.

The Aerobic Mesophilic Counts (AMC) of pickles remained almost unaffected through out the storage period whereas halophilic counts increased significantly ($p < 0.05$) on 60th day of storage (Table 2). There was no significant ($p < 0.05$) difference in microbial counts between control and low acid meat pickle. A gradual increase in bacterial counts of pickles was observed with increased storage time. But in this study, the microbial count was reported to remain satisfactory even after 60 days of storage at 32°C as the counts remained in the range of 4 log cycles. Khanna *et al.* (2004) reported that the aerobic mesophilic counts increased from 3.4 to 3.9 in pickles stored in PET jars at the end of six months storage. Halophilic counts increased significantly ($p < 0.05$) as storage period increases but remained satisfactory throughout the storage period. Comparatively slow rate of microbial multiplication was reported in vinegar based gizzard pickles and the product remained microbiologically safe even after 75 days of storage (Sachdev *et al.*, 1994). Yeast and mould counts remained below 12/g of pickles throughout the storage period. Pal and Agnihotri (1994) also reported the similar results.

Table 2: Changes in physico-chemical and microbiological quality of goat meat pickle during storage

Traits	Treatments	Storage period (days)					Treatment mean
		0	15	30	45	60	
pH	Control	4.670	4.670	4.710	4.720	4.730	4.700±0.01 ^B
	Low acid	4.840	4.860	4.880	4.880	4.910	4.870±0.01 ^A
TA (%AA)	Control	0.747 ^b	0.752 ^{ab}	0.760 ^{ab}	0.767 ^{ab}	0.790 ^a	0.763±0.01 ^A
	Low acid	0.682 ^b	0.685 ^b	0.683 ^b	0.692 ^b	0.707 ^a	0.696±0.01 ^B
AMC*	Control	3.880	3.880	4.020	3.980	4.060	3.960±0.25
	Low acid	3.990	4.030	4.080	4.070	4.120	4.060±0.19
Halophiles	Control	3.470 ^b	3.520 ^{ab}	3.580 ^{ab}	3.620 ^{ab}	3.950 ^a	3.630±0.06
	Low acid	3.530 ^b	3.610 ^b	3.730 ^{ab}	3.790 ^{ab}	4.110 ^a	3.750±0.07

Means in the same row and column with the different superscripts are significantly different ($p < 0.05$), TA: Titrable Acidity, AA: Acetic Acid, AMC: Aerobic Mesophilic Counts (log cfu g⁻¹), n = 6

Table 3: Sensory attributes* of goat meat pickle during storage at room temperature

Traits	Treatments	Storage period (days)					Treatment mean
		0	15	30	45	60	
Appearance	Control	6.87	6.75	6.67	6.83	6.67	6.76±0.13
	Low acid	7.33	6.75	6.67	6.67	6.67	6.82±0.11
Flavour	Control	6.93	6.85	6.50	6.30	6.29	6.57±0.18
	Low acid	7.08	7.04	7.00	6.53	6.33	6.80±0.11
Texture	Control	5.83	6.42	6.42	6.67	6.33	6.33±0.16
	Low acid	6.67	6.58	6.58	6.67	6.50	6.60±0.13
Saltiness	Control	6.75	6.67	6.67	6.33	6.17	6.52±0.14
	Low acid	6.83	6.83	6.75	6.67	6.67	6.75±0.12
Sourness	Control	6.00	6.00	6.00	5.92	5.75	5.92±0.18 ^b
	Low acid	6.50	6.58	6.67	7.00	7.08	6.77±0.13 ^a
Acceptability	Control	6.25	6.58	6.42	6.58	6.33	6.58±0.09 ^b
	Low acid	7.42	7.25	7.08	7.00	6.75	7.01±0.08 ^a

Means in the same row and column with the different superscripts are significantly different ($p < 0.05$), *: Based on 8 point scale (8 = extremely desirable; 1 = extremely undesirable), n = 21

Sensory attributes of the products such as appearance, flavour, texture and saltiness did not differ significantly between control and low acid goat meat pickles whereas sourness and overall acceptability were highly significant ($p < 0.01$). All the attributes did not alter significantly in low acid pickles and the product remained highly acceptable throughout the storage period (Table 3). Flavour, sourness and overall acceptability scores of low acid pickles ranged between good to very good over the entire period of storage. The scores for sourness and overall acceptability indicated that low acid meat pickles rated better than control whereas sensory panelists felt intense sourness in control samples. Low sourness of low acid pickles significantly affected its overall acceptability and improved the flavour of the products compared to the control. Similar findings were also reported by Pal and Agnihotri (1994) and Sen and Karim (2003).

CONCLUSIONS

No deteriorative changes were noticed in low acid goat meat pickles during the storage period under study. The microbial counts remained low and, all the sensory attributes were almost unaffected and rated between good to very good. Therefore, it can be concluded that highly acceptable low acid goat meat pickles can be prepared using male spent goat meat and can safely be stored for 60 days even during summer season.

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