Original Research

Quality Attributes and Storage Stability of Spent Hen Meat Pickle Prepared Using Different Acidulants

A. S. Khade, M. Raziuddin*, A. A. Devangare and M. A. Khan

Department of Livestock Products Technology, MAFSU, COVAS, Udgir, Maharashtra, INDIA

***Corresponding author:** dr_razi@rediffmail.com

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Abstract

The present study was carried out to evaluate the effect of incorporation of different acidulants viz. 1% acetic acid (control), 0.5% lactic acid and 0.5% citric acid on quality of spent hen meat pickle prepared from deboned spent hen. The pickle was evaluated for changes in physico-chemical, microbial and sensory attributes at an interval of 0, 15, 30, 45 & 60 days of storage at ambient temperature (37 ± 1ºC). Results revealed that pH valued did not differ significantly up-to 45 days of storage of pickle but on 60th day of storage, the pH of pickle significantly differed ($p<0.01$). TBA values of product decreased significantly ($p<0.01$) up-to 30 days of storage for control and different acidulants although TBA values increased significantly ($p<0.01$) from 45 to 60 days of storage. Microbial count and sensory quality did not show any appreciable changes in spent hen pickle and remained satisfactory throughout the storage period. It could be concluded that 0.5% citric acid and 0.5% lactic acid levels were more suited as an acidulants in the preparation of spent hen meat pickle and could be stored safely up to 60 days of storage at ambient temperature.

Key words: Coagulants, Microbial Quality, Sensory Quality, Spent Hen Meat

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Introduction

Meat pickles are ready to eat, convenient meat products with good shelf stability at ambient temperature. Pickling of meat offers highly delicious and nutritious ready to eat shelf stable product with relatively better shelf life (Arun *et al.*, 2007) therefore, it can provide a better avenue for rural entrepreneurship development (Gadekar *et al.*, 2010). Presently more emphasis is given on developing shelf stable meat products, which can be stored at ambient temperature (Anjaneyulu, 2005). Pickling of perishable foods in vinegar or edible oil with added salt, spices and condiments provide ready to eat products with good shelf stability at ambient temperature. Pickling also helps in improving desirable characteristics like taste, flavour and texture along

with preservative effect. Acidification of food to pH ≤ 4.6 is intended to prevent the growth of microorganisms and make the product shelf stable at room temperature (Hafiz *et al*., 2013). The growth of *Clostridium botulinum* can be prevented as its spores do not grow below pH 4.6 or at water activity below 0.94 (Solomon and Kautter, 1988). The pickling of meat through acidification has been studied across India (Arun *et al*., 2007; Gadekar *et al*., 2010; Malik and Sharma 2011). Arun *et al*. (2007) reported that the pH of meat pickles ranged from 4.4 to 4.7. The mechanism of the tenderizing action of acidic marinades is revealed to involve in the weakening of structures due to swelling of the meat and increased conversion of collagen to gelatin at low pH during cooking (Berge *et al*., 2001).

The availability of culled and spent hens has also increased many folds with rapid development of poultry layer industry. But the utilization and consumption of meat from the spent hens by the consumers is very limited because of poor sensory quality and toughness of meat and less juiciness when compared to broiler meat as it is harvested at the end of the egg laying capacity of the birds. So the poultry farmers find difficulty in the disposal of spent hens. Hence, attempts should be made for obtaining better returns by the way of adopting suitable methods for profitable disposal of spent hens. Changes in life style, increased per capita income, urbanization, consumer awareness and increasing number of women entering in job has created rising demand for ready to eat, heat and serve convenience meat products. Application of suitable and acceptable processing technology leading to value addition of spent chicken meat would be suitable remedy to its disposal problem besides enhancing its acceptability as it will suit the taste buds of local consumers. Pickling of meat with edible oil, salt, spices, condiments and vinegar not only enhances its acceptability but also provides better storage life even at ambient temperature. Hence, the current work was undertaken to utilize the spent hen meat to prepare pickle using different acidulants and study its shelf life at room temperature.

Materials and Methods

The study was conducted in the department of Livestock Products Technology of the College of Veterinary and Animal Sciences, MAFSU, Udgir, Maharashtra, India, during the months of March to September 2018.

Meat Sources

Spent hens around 72 weeks of age were procured from local market of Udgir city of Latur district and slaughtered by traditional Halal method. The body fat, tendons and separable connective tissue were trimmed off. The dressed meat was packed in polyethylene pouches and kept in refrigerator at 4±1ºC about 24 hours for conditioning after which they are deboned and cut into cubes of 0.5 to 1.0 inches in size for use in the experiments

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Spent Hen Meat Pickle Process

Spent hen meat pickle was prepared as per the formulation and method suggested by Ankur Das *et al*., (2012) using some modification with following spice mix composition (Table 1).

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

S. No.	Spice Ingredients	Quantity Percent (on Fresh Meat Weight)
1	Chili Powder	1.1
2	Turmeric Powder	0.45
3	Coriander Powder	0.55
4	Cumin Powder	0.55
5	Black Pepper Powder	0.12
6	Cinnamon Powder	0.17
7	Clove Powder	0.11
8	Large Cardamom Powder	0.17
9	Commercial Chicken Masala	1
10	Onion	10
11	Ginger	4.2
12	Garlic	4.3
13	Mustard oil	25

Lean meat cubes after conditioning for 24 hr. at 4±1ºC were pressure cooked (1.2 kg/ 2 cm at 120 °C) for 10 minutes and fried in mustard oil (350°C) till it develops a golden brown colour. After removal of the fried meat cubes, spices mix (Table1) prepared as per the recipe of Ankur Das *et al*. (2012) with some modifications were added to the oil and fried thoroughly for 2 minutes. The left out broth was added to the spices mix as per the requirement with constant stirring and allowed to boil for 1 minute. The fried meat cubes were then added to the gravy and further cooked with occasional stirring for 3 minutes and followed by 1 % acetic acid addition and allowed to cool at room temperature. This was considered as control whereas in case of treatment samples different acidulants like 0.5 % citric acid and 0.5 % lactic acid were used. The cooled meat pickle was then packed in pet jars and stored in a dry place at ambient temperature (37 ± 1ºC) for studying the product's shelf life and other quality attributes.

Analysis of Sample

The changes in physico-chemical, microbial and organoleptic properties were studied at regular interval 0,15,30,45 & 60 days of storage at ambient temperature (37 ± 1ºC). The pH of the spent hen meat pickle was determined using combined electrode of a digital pH meter. The procedure outlined by Fisher and Peters (1968) was used for Titrable acidity estimation. Thiobarbituric acid value (TBA) of spent hen meat pickle was estimated by the method suggested by Witte *et al*. (1970). Total plate count and yeast & mold count in the sample were determined by the method describe 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 sample were

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prepared in sterile 0.1 peptone water and plated in duplicate. The incubation time and temperature plates was 35 ± 1 ºC for 24 hours for total plate count whereas, the plates were incubated at 25ºC for 5 days for yeast and mould count. Three similar trials were conducted and results were statistically analyzed as suggested by Snedecor and Cochran (1989).

Table 2: Physico-chemical characteristics of spent hen meat pickle at ambient temperature (37 ± 1 ºC)

Type of Product	Storage Period					Treatment Mean
	0	15	30	45	60	
	pH					
Control (1% Acetic acid)	4.50 ± 0.35^{a}	4.73 ± 0.31^{a}	4.96 ± 0.17^{a}	5.08 ± 0.08^{a}	5.10 ± 0.10^{b}	**4.876**^{a}
Citric acid 0.5 %	4.49 ±0.00^{a}	4.78 ± 0.00^{a}	5.00 ± 0.01^{a}	5.18 ± 0.10^{a}	5.22 ± 0.00^{a}	**4.934**^{a}
Lactic acid 0.5 %	4.50 ±0.00^{a}	4.75 ± 0.00^{a}	4.98 ± 0.00^{a}	5.10 ± 0.10^{a}	5.14 ± 0.00^{b}	**4.894**^{a}
Storage Period Mean	**4.497**^{a}	**4.756**^{b}	**4.980**^{ab}	**5.120**^{a}	**5.153**^{c}	
	Titrable Acidity					
Control (1% Acetic acid)	0.74 ± 0.01^{a}	0.73 ± 0.01^{a}	0.71 ± 0.00^{a}	0.74 ± 0.01^{a}	0.84 ± 0.01^{a}	**0.752**^{b}
Citric acid 0.5 %	0.72 ± 0.00^{a}	0.70 ± 0.00^{a}	0.68 ± 0.01^{a}	0.71 ± 0.00^{a}	0.81 ± 0.00^{b}	**0.724**^{a}
Lactic acid 0.5 %	0.74 ± 0.00^{a}	0.72 ± 0.00^{a}	0.70 ± 0.00^{a}	0.74 ± 0.00^{a}	0.83 ± 0.01^{a}	**0.746**^{b}
Storage Period Mean	**0.733**^{c}	**0.717**^{b}	**0.697**^{a}	**0.730**^{bc}	**0.827**^{d}	
	TBA (mg malonaldehyde /Kg)					
Control (1% Acetic acid)	0.66 ± 0.02^{b}	0.50 ± 0.09^{b}	0.49 ± 0.05^{b}	0.54 ± 0.06^{b}	0.61 ± 0.04^{c}	**0.560**^{a}
Citric acid 0.5 %	0.69 ± 0.00^{a}	0.53 ± 0.00^{a}	0.52 ± 0.00^{a}	0.64 ± 0.00^{a}	0.70 ± 0.01^{a}	**0.616**^{b}
Lactic acid 0.5 %	0.67 ± 0.01^{a}	0.52 ± 0.00^{b}	0.50 ± 0.02^{b}	0.56 ± 0.00^{b}	0.64 ± 0.00^{b}	**0.578**^{a}
Storage Period Mean	**0.673**^{a}	**0.517**^{a}	**0.503**^{a}	**0.580**^{b}	**0.650**^{c}	

Sensory Evaluation of Spent Hen Meat Pickle

The sensory panel from academic staff members of College of Veterinary & Animal Sciences, Udgir were involved to assess the quality of spent hen meat pickle on the basis of sensory attributes *viz.* appearance, flavor, juiciness, texture & over all acceptability using 8 point descriptive scale (Keeton, 1983) where '8' denoted extremely desirable and '1' denoted extremely poor.

Result and Discussion

Results showed that the pH of spent hen meat pickles prepared with different acidulants ranged between 4.49 ± 0.00 to 5.22 ± 0.00 for 0.5% citric acid and 4.50 ± 0.00 to 5.10 ± 0.10 for 0.5% lactic acid in the total study and values did not differ significantly up-to 45 days of storage but significant differences ($p<0.01$) were observed on 60th day of storage. The values of pH has further strengthened the reports of Nayak *et al.* (2011) and Das *et al*. (2007), who also studied the pH variation of chicken meat pickle and goat meat pickle stored at room temperature. Further, among the treatment pickles prepared using different acidulants non-significant differences were observed up-to 60 days of storage. The overall mean of titrable acidity of control, 0.5% citric acid and 0.5% lactic acid samples were 0.84 ± 0.01, 0.81 ± 0.00 and 0.83 ±

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0.01. This difference was due to the concentration and different acids used as acidulants. There were non-significant differences in titrable acidity of control and different acidulants (citric acid & lactic acid).

Table 3: Microbial quality of spent hen meat pickle during storage at ambient temperature (37 ± 1 °C)

Type of Product	Storage Period					Treatment Mean
	0	15	30	45	60	
TPC						
Control (1% Acetic acid)	1.75 ± 0.00^{b}	2.73 ± 0.01^{b}	3.38 ± 0.11^{b}	3.65 ± 0.10^{b}	3.90 ± 0.10^{b}	3.082^{a}
Citric acid 0.5 %	1.78 ± 0.10^{a}	2.79 ± 0.01^{a}	3.44 ± 0.01^{a}	3.71± 0.02^{a}	4.10 ± 0.03^{a}	3.164^{b}
Lactic acid 0.5 %	1.76 ± 0.01^{b}	2.75 ± 0.01^{b}	3.40 ± 0.01^{b}	3.68 ± 0.00^{b}	3.94 ± 0.01^{b}	3.106^{a}
Storage period mean	**1.763^{a}**	**2.757^{b}**	**3.407^{c}**	**3.680^{d}**	**3.980^{d}**	
Yeast and Mould Count						
Control (1% Acetic acid)	1.40 ± 0.00^{c}	1.69 ± 0.00^{c}	2.30 ± 0.03^{c}	2.72 ± 0.00^{c}	2.78 ± 0.00^{c}	2.178^{a}
Citric acid 0.5 %	1.46 ± 0.00^{a}	1.86 ± 0.00^{a}	2.42 ± 0.00^{a}	2.79 ± 0.00^{a}	2.86 ± 0.01^{a}	2.278^{c}
Lactic acid 0.5 %	1.44 ± 0.01^{b}	1.74 ± 0.01^{b}	2.37 ± 0.01^{b}	2.74 ± 0.01^{b}	2.80 ± 0.01^{b}	2.218^{b}
Storage period mean	**1.433^{a}**	**1.763^{b}**	**2.363^{c}**	**2.750^{d}**	**2.813^{d}**	

Titrable acidity of spent hen meat pickle did not show any significantly changes up to 45th days of storage between control and treatments but with increase in storage period of 60th days, the titrable acidity increased significantly ($p<0.01$) in control as well as treatments. However, the titrable acidity of pickle decreased non-significantly up-to 45th days of storage but later on increased significantly up to 60th days of storage period. The result was accordance with Pal and Agnihotri (1994) for storage stability of chevon pickle at room temperature. The increase in titrable acidity could be due to more loss of moisture, which in turn could have increased the concentration of control and other treatments. The result of TBA values (mg malonaldehyde/ kg) were 0.61 ± 0.04, 0.70 ± 0.01 and 0.64 ± 0.00 respectively for control, 0.5% citric acid and 0.5% lactic acid at 60 days of storage. There were non-significant differences in TBA value among control and treatments. TBA values of pickle decreased significantly ($p<0.01$) up to the storage period of 30th das for all the treatments. The TBA values increased significantly ($p<0.01$) storage to 60th days. The increase in TBA values particularly at the end of storage is indicative of oxidative rancidity. As in the present study decrease and increase in TBA value during storage were recorded by Biswas *et al.* (2011) for duck patties stored at refrigeration temperature.

The TPC (total plate count) of the spent hen meat pickle recorded at various periods of storage were found to differ significantly ($p<0.01$). The initial mean TPC was recorded to be 1.75 ± 0.00, 1.78 ± 0.10, and 1.76 ± 0.01 log cfu/ g which increased significantly to 3.90 ± 0.10, 4.10 ± 0.03 and 3.94 ± 0.01 log cfu/ g of spent hen meat pickle on 60th day of storage at ambient temperature for control, 0.5% citric acid and 0.5% lactic acid respectively. Nayak *et al.* (2011) also reported similar trends in TPC of meat pickle stored for different storage periods, however, Khanna *et al.* (2004) stated that the aerobic mesophilic count increased from 3.4 to 3.9 in pickles stored in PET jars at the end of six month of storage. Kanagaraju and Subramanian

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(2012) observed a non-significant increase in the TPC of spent duck meat pickle. Yeast and mold count of spent hen meat pickle prepared from control and different acidulants was non-significant among the treatment up-to 60 days of storage. However, growth of yeast and moulds were increased significantly ($p<0.01$) from 1.40 ± 0.00, 1.46 ± 0.00 and 1.44 ± 0.01 cfu/g. to 2.78 ± 0.00, 2.86 ± 0.01 and 2.80 ± 0.01 cfu/g. of spent hen meat pickle on 60 days of storage at ambient temperature for control, 0.5% citric acid and 0.5% lactic acid respectively. Pal (1990) reported a significant ($p<0.01$) increase in halophilic and yeast & mold count of pork pickle with increasing storage period. The findings of the present study correlated well with the report Kumar and Bachhil (1993); Shukla and Srivastav (1999). The microbiological quality of spent hen meat pickle remained satisfactory for entire period of storage for all the treatments as the count remained in the range of 3 log cycles which is similar to the observation of Pal and Agnihotri (1994).

Table 4: Storage related changes in sensory attributes of spent hen meat pickle incorporated with different acidulants and stored at ambient temperature (37±1°C)

Type of Product	Storage Period					Treatment Mean
	0	15	30	45	60	
	Colour & Appearance					
Control (1% Acetic acid)	7.45 ± 0.00^{a}	7.28 ± 0.01^{a}	7.1 ± 0.00^{a}	7.04 ± 0.01^{a}	6.97 ± 0.01^{a}	7.048^{a}
Citric acid 0.5 %	7.24 ± 0.01^{c}	7.14 ± 0.00^{c}	6.95 ± 0.01^{c}	6.9 ± 0.00^{c}	6.74 ± 0.00^{c}	6.834^{c}
Lactic acid 0.5 %	7.32 ± 0.01^{b}	7.19 ± 0.00^{b}	7.06 ± 0.01^{b}	6.98 ± 0.00^{b}	6.88 ± 0.00^{b}	6.918^{b}
Storage Period Mean	**7.387^{a}**	**7.140^{b}**	**7.020^{c}**	**6.847^{d}**	**6.273**	
	Flavour					
Control (1% Acetic acid)	7.35 ± 0.01^{a}	7.1 ± 0.00^{a}	6.92 ± 0.00^{a}	6.83 ± 0.00^{a}	6.69 ± 0.00^{a}	6.978^{a}
Citric acid 0.5 %	7.18 ± 0.00^{b}	6.98 ± 0.00^{c}	6.65 ± 0.00^{c}	6.52 ± 0.00^{c}	6.39 ± 0.00^{c}	6.744^{c}
Lactic acid 0.5 %	7.2 ± 0.01^{b}	7.08 ± 0.00^{b}	6.86 ± 0.00^{b}	6.73 ± 0.00^{b}	6.49 ± 0.00^{b}	6.872^{b}
Storage Period Mean	**7.243^{a}**	**7.053^{b}**	**6.810^{c}**	**6.693^{d}**	**6.523^{d}**	
	Body & Texture					
Control (1% Acetic acid)	7.10 ± 0.00^{a}	6.94 ± 0.00^{a}	6.78 ± 0.00^{a}	6.69± 0.00^{a}	6.57 ± 0.00^{a}	6.816^{a}
Citric acid 0.5 %	7.01 ± 0.00^{b}	6.76 ± 0.00^{c}	6.65 ± 0.00^{c}	6.52 ± 0.01^{c}	6.39 ± 0.01^{b}	6.666^{c}
Lactic acid 0.5 %	7.03 ± 0.00^{b}	6.90 ± 0.00^{b}	6.70 ± 0.04^{b}	6.64 ± 0.00^{b}	6.40 ± 0.00^{b}	6.734^{b}
Storage Period Mean	**7.047^{a}**	**6.867^{b}**	**6.710^{c}**	**6.617^{d}**	**6.453^{d}**	
	Juiciness					
Control (1% Acetic acid)	7.25 ± 0.00^{a}	7.18 ± 0.00^{a}	6.98 ± 0.00^{a}	6.38 ± 0.01^{a}	6.22 ± 0.00^{a}	6.802^{a}
Citric acid 0.5 %	7.05 ± 0.00^{c}	6.95 ± 0.00^{c}	6.74 ± 0.00^{c}	6.18 ± 0.00^{c}	6.01 ± 0.00^{c}	6.586^{c}
Lactic acid 0.5 %	7.15 ± 0.00^{b}	7.04 ± 0.00^{b}	6.84 ± 0.01^{b}	6.27 ± 0.00^{b}	6.08 ± 0.01^{b}	6.676^{b}
Storage Period Mean	**7.150^{a}**	**7.057^{b}**	**6.853^{c}**	**6.277^{d}**	**6.103^{d}**	
	Overall Acceptability					
Control (1% Acetic acid)	7.45 ± 0.00^{a}	7.28 ± 0.01^{a}	7.10 ± 0.00^{a}	7.04 ± 0.01^{a}	6.97 ± 0.01^{a}	7.168^{a}
Citric acid 0.5 %	7.24 ± 0.01^{c}	7.14 ± 0.00^{c}	6.95 ± 0.01^{c}	6.90 ± 0.00^{c}	6.74 ± 0.00^{c}	6.994^{c}
Lactic acid 0.5 %	7.32 ± 0.01^{b}	7.19 ± 0.00^{b}	7.06 ± 0.01^{b}	6.98 ± 0.00^{b}	6.88 ± 0.00^{b}	7.086^{b}
Storage Period Mean	**7.337^{a}**	**7.203^{b}**	**7.037^{c}**	**6.973^{d}**	**6.863^{d}**	

Sensory attributes of the spent hen meat pickle such as colour & appearance, flavor, body & texture, juiciness and overall acceptability did not differ significantly between control, 0,5% citric acid and 0.5%

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lactic acid. Similar results were also reported by Raut *et al.* (2015). All the sensory attributes of spent hen meat pickle declined significantly (P<0.01) from 0 to 60 days of storage in control, 0.5% citric acid and 0.5% lactic acid. However, Pal (1990) had reported that significantly decline in appearance of products might be due to changes in colour with storage period. A decrease in flavour scores along with the progression of storage period was also reported by Sen and Karim (2003) in rabbit meat pickle. The decreased in the overall acceptability scores of the spent hen meat pickle might be effect to the progressive decrease in the mean colour, flavour, texture and juiciness scores. Comparable findings were also recorded by Kanagaraju and Subramanian (2012) and Das *et al.* (2007).

Conclusion

Different acidulants can be efficiently utilized to prepare value added ready-to-eat spent hen meat pickle with superior sensory quality, high nutritive value and the remains safe for consumption up to 60 day of storage at ambient temperature (37 $\pm$ 1^{o}C) .

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