

Original Research Article

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Comparative Study of the Shelf Life of Ready to Eat and Shelf Stable Meat Pickle Prepared from Spent Duck, Chicken and Turkey Meat

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ABSTRACT

An experiment was under taken to study the processing of shelf stable intermediate moisture type duck, chicken and turkey meat pickle and to evaluate storage stability of pickles at ambient temperature (32±2°C). The storage studies were conducted at an interval of 15days till 90 days period. Pre-cooked and fried lean minced chicken, duck and turkey meat was mixed separately with vinegar, salt, spices and condiments and packed air tight in glass jar. Average cooking yield of duck, chicken and turkey meat pickle were 59.1%, 57.2% and 58.8% respectively. Proximate composition, pH, TBA values, microbiological qualities and sensory qualities of the pickles were studied as per standard procedure. The mean per cent moisture, crude protein, ether extract and total ash contents of duck pickles were 36.18, 17.82, 39.64, and 3.71 respectively. The mean per cent moisture, crude protein, ether extract and total ash contents of chicken pickles were 59.74, 18.56, 15.92, and 3.51 respectively. The mean per cent moisture, crude protein, ether extract and total ash contents of turkey pickles were 61.78, 16.02, 16.74, and 3.28 respectively. The pathogenic bacteria like *Salmonella spp.*, *Clostridium spp.*, *Staphylococcus spp.* and *E. coli* were found absent in duck, chicken and turkey meat pickle during the entire storage period. The product had appreciable sensory quality and low total microbial, yeast and mould counts. The sensory scores revealed that the pickle was acceptable even up to 90 days storage. High perishability of meat either in fresh or in processed forms is serious problem in tropical countries. Now-a-days, there is need to develop the foods which are shelf-stable so that can be distributed in various locations without aid of any refrigeration. Pickling is one of the alternative solutions to develop such kind of products.

Keywords

Meat pickle, spent chicken, Spent duck, Spent turkey, Storage stability, Quality attributes

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Introduction

Poultry meat and eggs are one of the most widely consumed animal origin foodstuff in a

wide variety of cultures, traditions and religions across the whole world. In India, the total poultry population is 851.81 million in 2019 (20th Livestock Census Report, 2019,

Ministry of Fisheries, Animal Husbandry & Dairying, Govt. of India). Poultry is one of fastest growing segments of the agricultural sector in India with around 8% growth rates per annum (Chatterjee and Rajkumar, 2015). As per World Bank projection, demand for food will increase by 50% and for meat by 85% by 2030 (Guleria *et al.*, 2015). Among other poultry birds, ducks occupy next to chicken in poultry meat production i.e. agricultural economy in India. In 2016 the duck population (*Anas spp.*) were reached 1.24 billion throughout the world and 1.1 billion in Asia. Asia is holding 82.2% production of duck meat and has also the highest increase of total and of per capita duck meat by 308% and 244%, respectively (Sumarmono, 2019). People consuming duck meat is due to its high nutritional value with high percentage of polyunsaturated fatty acids and balanced ratio between omega-3 fatty acids and omega-6 (Sumarmono, 2019). Spent hen and spent ducks are the by-products of layer industry. Spent ducks meat is tough, less juicy and fetches fewer prices which contribute to the economic losses in the layer poultry industry (Jayanthi, 2008). Duck meat has higher myoglobin in muscle fibers of breast muscle compared to chicken, and is considered as red meat. Moreover, due to stronger gamey flavour of duck meat and high fat content (13.8%) it may be less appreciated by the consumer. Development and diversification of ready-to-eat duck meat products is expected to increase consumption levels to the consumers has been reported (Biswas, 2019). Shelf stable meat products like meat pickles, canned meat, cured meat and snack type meat products have been reported (Anjaneyulu, 2005). From the ancient time, Pickling is used as methods of preservation of raw materials like fruits, vegetables etc. Pickled products are very common in Indian daily diets and are much relished by common people i.e. consumers. Presently more emphasis is given on

developing shelf stable ready to eat meat products which can be stored in ambient temperature. Hence, duck and turkey meat production with its physicochemical properties, processing and development of value-added ready-to-eat products is discussed in detail to explore its importance as an alternative to chicken.

Materials and Methods

The present study was conducted to identify the quality and acceptability of meat pickle prepared from spent ducks, hens and turkey birds at the Department of Livestock Products Technology, Faculty of Veterinary & Animal Sciences, West Bengal University of Animal and Fishery Sciences, Kolkata-37, West Bengal, India. The work was carried out from June 2020 to September 2020, when the average temperature was $32\pm 2^{\circ}\text{C}$. Culled and spent ducks, hens and turkey birds were procured from the local poultry farm for the study. The birds were slaughtered by humane method, then dressed hygienically and deboned. Scientific slaughter, dressing, deboning was done in the poultry processing unit of the Department of Livestock Products Technology, West Bengal University of Animal and Fishery Sciences, Kolkata as per the standard procedure of Sahoo and Panda (1983) with slight modification. After slaughtering and dressing, the carcasses were manually deboned as per the method of Staff and Darrow (1953). Deboned meat was stored in deep freezer (-18°C) for further use. Frozen meat was thawed in the refrigerator for making meat pickle. Recipe of meat pickle is presented in table. Meat pieces of about 4 sq. cm (approximately) were marinated in 3% vinegar (v/v) added with pinch of turmeric and common salt for 4 hours at $4\pm 1^{\circ}\text{C}$. After marinating, meat pieces were removed from vinegar and pressure cooked ($1.1\text{kg}/\text{cm}^2$ at 120°C) for 10 minutes and fried in refined vegetable oil (300°C) till it develops a golden

brown colour and was kept separately. Dry spices were fried in the same oil for about one minute and broth was then added and heated with constant stirring till boiling started. Fried meat pieces were added to it and allowed to boil for 2 minutes. A top up quantity of heated and cooled refined oil was added to the pickle and it was kept for maturation for 24 hours at room temperature. The cooled meat pickle was then packed in pet bottles and stored in a dry place at room temperature ($32\pm 2^{\circ}\text{C}$) for studying the product's shelf life and other quality attributes.

Moisture, crudes protein, ether extract and total ash were estimated as per AOAC (1984). The pH value of the prepared pickle was determined by using a digital pH Meter (Systronics, Model 335) and by following the method as described by Pippen *et al.*, while the TBA value (mg malanaldehyde/ kg) of the product was determined by using a Lomb and Bousch Spectrophotometer at 530 nm following the standard method as described by Witte *et al.*, (1970).

The Total viable count and yeast and mould counts of ready-to-eat and shelf stable pickles were determined as described by Harrigan and McCancy and the results were expressed as log cfu (colony forming unit) per g of meat. Standard plate count agar (Make: HiMedia, Code- M091) and Rose Bengal Chloramphenicol Agar (Make: HiMedia, Code- M640) were used for total viable count (TVC) and yeast and moulds count (YMC) respectively.

The sensory evaluations were conducted using an 8 – point descriptive scale (Keeton *et al.*, 1984) where 8 denoted 'extremely desirable' and 1 denoted 'extremely poor'. A sensory panel (semi-trained) of six judges drawn from post-graduate, Ph.D. students of departments of Faculty of Veterinary and Animal Sciences, WBUAFS, Belgachia,

Kolkata was requested to evaluate the product for different quality attributes. All the spent duck, chicken and turkey meat pickles were evaluated for the above mentioned quality attributes at 30 days intervals and up to 90 days of storage at room temperature.

All the data obtained in the present investigation were analyzed statistically to draw a valid conclusion by using SPSS-20® software. Six replicates were performed for each experiment. The results were expressed as mean and standard error (SE) of mean. The means were analyzed by using Two-way ANOVA (for storage parameters) and means were compared using Tukey's HSD Post-Hoc test at 5% level of significance in a SPSS-20® software package.

Results and Discussion

The results of the present study are presented in following table no. 2, 3 and 4. Average cooking yield of duck, chicken and turkey meat pickle were 59.1%, 57.2% and 58.8% respectively. The mean percentage of moisture, crude protein, ether extract and total ash contents of duck pickles were 36.18, 17.82, 39.64, and 3.71 respectively. The mean per cent moisture, crude protein, ether extract and total ash contents of chicken pickles were 59.74, 18.56, 15.92, and 3.51 respectively. The mean of per cent moisture, crude protein, ether extract and total ash contents of turkey pickles were 61.78, 16.02, 16.74, and 3.28 respectively. These observations were in close agreement with the reports of Kangarajju and Subramanian (2012) in vinegar based duck meat pickle and also similar with the reports of Anna and Sobana (2020) in turkey meat pickle and das *et al.*, (2013) in spent chicken meat pickle at room temperature.

The mean values for changes in physico-chemical characteristics of spent duck, chicken and turkey meat pickle during room

temperature storage are presented in Table 2. The pH values of duck, chicken and turkey meat pickle decreased significantly ($P < 0.05$) with increasing storage period and which was below 5.0, that is considered to be critical for storage stability of pickled meat products (Dziezak, 1986). Sachdev *et al.*, (1994) reported that pH of chicken meat pickle decreased significantly ($P < 0.01$) from 20th day. TBA values of duck, chicken and turkey meat pickle were increased significantly ($p < 0.05$) with increasing storage period. The present finding is in conformity with (Wastt, 1962). Increase in TBA values might be due to increase the production of volatile metabolites due to lipid oxidation in aerobic packaging. Increases in TBA values during storage period of various meat pickle were also reported earlier by Das *et al.*, (2012), Maiti *et al.*, (2009) and Pal and Agnihotri (1994).

The mean values for changes in microbiological characteristics of duck, chicken and turkey meat pickle at room temperature during storage are presented in

Table 3. Total viable counts and yeast and mould counts were increased significantly with increasing storage period and total viable counts were also differ between species meat pickle (Jay, 1996). Coliform spp., Salmonella spp., Clostridium spp. counts and staphylococcal counts were not detected throughout entire storage period up to 90 days. Throughout entire storage period, pathogenic microorganisms were not detected. This might be due to the heat treatment during cooking and addition of vinegar used for pickling that lead to retardation of microbial growth (Wani and Majeed, 2014). Yeast and mould counts were not detected between day 0 to 30 of storage thereafter yeast and mould counts were detected on 60th day of storage. The microbial characteristics were reported in the present study were remained satisfactory up to 90 days of storage at room temperature. Similar observations were also recorded by Kumar and Bachil (1993) in pork pickle, Pal and Agnihotri (1994) in chevon meat pickle and Jayanthi *et al.*, (2008) in spent hen meat pickle.

Table.1 Recipe of spices mixture used in the chicken pickle as per Das *et al.*, (2013) with some modifications

Sl. No	Ingredients	Percent (on fresh meat weight)
1.	Onion	28.00
2.	Ginger	4.20
3.	Garlic	4.30
4.	Commercial Chicken Masala	1.00
5.	Common Salt	2.5
6.	Cardamom Powder	0.17
7.	Clove Powder	0.11
8.	Cinnamon Powder	0.17
9.	Black Pepper Powder	0.12
10.	Cumin Powder	0.55
11.	Coriander Powder	0.55
12.	Turmeric Powder	0.45
13.	Chili Powder	1.10
14.	Vinegar	3

Table.2 Changes in physic-chemical characteristics of spent duck, chicken and turkey meat pickle during storage period at room temperature

Parameters	Storage periods in Days											
	0 Day			30 th Day			60 th Day			90 th Day		
	Duck Pickle	Chicken Pickle	Turkey Pickle	Duck Pickle	Chicken Pickle	Turkey Pickle	Duck Pickle	Chicken Pickle	Turkey Pickle	Duck Pickle	Chicken Pickle	Turkey Pickle
pH	4.74±0.01 ^{ax}	4.67±0.02 ^{ay}	4.72±0.03 ^{ax}	4.66±0.02 ^{bx}	4.59±0.02 ^{by}	4.62±0.00 ^{bx}	4.57±0.01 ^{cx}	4.48±0.02 ^{cy}	4.54±0.02 ^{cx}	4.44±0.01 ^{dx}	4.39±0.02 ^{dy}	4.48±0.01 ^{dx}
TBA (mg malonaldehyde/kg)	0.668±0.002 ^{ax}	0.554±0.002 ^{ay}	0.661±0.006 ^{ax}	0.779±0.001 ^{bx}	0.655±0.005 ^{by}	0.765±0.005 ^{bx}	0.887±0.002 ^{cx}	0.754±0.004 ^{cy}	0.863±0.006 ^{cx}	0.949±0.012 ^{dx}	0.900±0.007 ^{dy}	0.959±0.006 ^{dx}

* Interaction means bearing different superscripts between storage days within rows (a, b, c, d) differ significantly (P < 0.05)

** Interaction means bearing different superscripts between species within rows (x, y, z) differ significantly (P < 0.05)

Table.3 Changes in microbial quality of shelf stable spent duck, chicken and turkey meat pickle during storage period at ambient temperature (Storage periods in days, microbial counts in log values)

Parameters	Storage Days											
	0 Day			30 th Day			60 th Day			90 th Day		
	Duck Pickle	Chicken Pickle	Turkey Pickle	Duck Pickle	Chicken Pickle	Turkey Pickle	Duck Pickle	Chicken Pickle	Turkey Pickle	Duck Pickle	Chicken Pickle	Turkey Pickle
Total Viable Count	2.57±0.06 ^{ax}	2.42±0.04 ^{axy}	2.39±0.04 ^{ay}	2.89±0.06 ^{bx}	2.78±0.04 ^{bxy}	2.69±0.04 ^{by}	3.52±0.07 ^{cx}	3.57±0.04 ^{cxy}	3.43±0.08 ^{cy}	4.47±0.06 ^{dx}	4.41±0.07 ^{dxy}	4.34±0.08 ^{dy}
Salmonella spp. Count	Nil	Nil	Nil									
Yeast & Mould Count	Nil	Nil	Nil	Nil	Nil	Nil	2.39±0.07 ^{ax}	2.44±0.05 ^{ax}	2.38±0.05 ^{ax}	2.67±0.03 ^{bx}	2.65±0.03 ^{bx}	2.62±0.05 ^{bx}
Coliforms Count	Nil	Nil	Nil									
Staphylocococcus spp. Count	Nil	Nil	Nil									
Clostridium spp. Count	Nil	Nil	Nil									

* Interaction means bearing different superscripts between storage days within rows (a, b, c, d) differ significantly (P < 0.05)

** Interaction means bearing different superscripts between species within rows (x, y, z) differ significantly (P < 0.05)

Table.4 Changes in organoleptic qualities of spent duck, chicken and turkey meat pickle during storage periods at room temperature

Parameters	Storage Periods in Days											
	0 Day			30 th Day			60 th Day			90 th Day		
	Duck Pickle	Chicken Pickle	Turkey Pickle	Duck Pickle	Chicken Pickle	Turkey Pickle	Duck Pickle	Chicken Pickle	Turkey Pickle	Duck Pickle	Chicken Pickle	Turkey Pickle
General appearance	7.76±0.04 ^{ax}	7.78±0.04 ^{ax}	7.74±0.05 ^{ax}	7.52±0.03 ^{bx}	7.49±0.04 ^{bx}	7.38±0.06 ^{bx}	6.99±0.04 ^{cx}	7.02±0.04 ^{cx}	7.02±0.05 ^{cx}	6.82±0.02 ^{dx}	6.67±0.03 ^{dx}	6.74±0.04 ^{dx}
Flavour	7.75±0.03 ^{ax}	7.77±0.03 ^{ax}	7.72±0.05 ^{ax}	7.46±0.04 ^{bx}	7.40±0.06 ^{bx}	7.38±0.04 ^{bx}	7.02±0.04 ^{cx}	7.01±0.05 ^{cx}	7.01±0.04 ^{cx}	6.65±0.04 ^{dx}	6.67±0.04 ^{dx}	6.65±0.05 ^{dx}
Texture	7.79±0.04 ^{ax}	7.76±0.03 ^{ax}	7.73±0.05 ^{ax}	7.48±0.05 ^{bx}	7.17±0.24 ^{bx}	7.34±0.03 ^{bx}	7.00±0.04 ^{cx}	7.00±0.05 ^{cx}	6.97±0.03 ^{cx}	6.60±0.04 ^{dx}	6.62±0.57 ^{dx}	6.65±0.05 ^{dx}
Juiciness	7.78±0.04 ^{ax}	7.75±0.04 ^{ax}	7.79±0.04 ^{ax}	7.50±0.05 ^{bx}	7.28±0.04 ^{bx}	7.33±0.04 ^{bx}	6.95±0.03 ^{cx}	7.01±0.04 ^{cx}	6.99±0.04 ^{cx}	6.47±0.05 ^{dx}	6.55±0.03 ^{dx}	6.71±0.04 ^{dx}
Overall Acceptability	7.77±0.03 ^{ax}	7.77±0.04 ^{ay}	7.77±0.04 ^{ay}	7.47±0.03 ^{bx}	7.44±0.06 ^{by}	7.34±0.05 ^{by}	6.97±0.06 ^{cx}	6.96±0.04 ^{cy}	6.97±0.04 ^{cy}	6.50±0.04 ^{dx}	6.59±0.04 ^{dy}	6.60±0.04 ^{dy}

* Interaction means bearing different superscripts between storage days within rows (a, b, c, d) differ significantly (P < 0.05).

** Interaction means bearing different superscripts between species within rows (x, y, z) differ significantly (P < 0.05).

The mean values for changes in sensory attributes of duck, chicken and turkey meat pickle during room temperature storage are presented in Table 4. A significantly gradual decline in sensory attributes such as general appearance, flavour, texture, juiciness and overall acceptability was observed during the entire storage period up to 90 days. Sensory evaluation of various species meat pickles showed that spent duck, hen and turkey meat pickle was acceptable even at the end of 90 days storage at ambient temperature. These observations were in close agreement with the reports of Kangaraju and Subramanian (2012) in vinegar based duck meat pickle. These observations were also closely similar to those observed by khanna *et al.*, (2004) in bone-in meat pickle from spent hen and also agreement with observation of Das *et al* (2007) in goat meat pickle. A decrease in flavour scores along with increase the storage period was also studied by Sen and Karim (2003) in rabbit meat pickle. The significant decrease in flavour scores on prolonged storage period at room temperature might be due to the corresponding increase in TBA values of the meat products.

Similar observations of decrease in overall acceptability of pickle with increasing storage period in various meat pickles were also studied by (Pal and Agnihotri (1994), Janathi *et al.*, (2008). As, the results obtained from the present study of physico-chemical, microbiological and organoleptic evaluation, it may be stated that vinegar based spent duck, hen and turkey meat pickle acceptable to the local consumers and storage stability up to 90 days at ambient temperature. This is also opened a gateway of entrepreneurial opportunity for the unemployment youth, rural poor villagers, marginal poultry farmers, self-help groups and especially rural women folk to take up this opportunity as a source of additional income.

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