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Storage Stability of Minced Chicken Meat and Pork at Ambient Temperature

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ABSTRACT

With the increase in human population, the demand for food has also risen up. The food processing outlets mostly handle minced meat at ambient temperatures to cater the consumers choice. Identifying the exact spoilage time can safeguard the health of the consumer and also minimize the losses to the food handlers. With this outlook a work was designed in order to study the spoilage pattern of chicken meat and pork at ambient temperature. The chicken meat and pork were procured hygienically from scientifically slaughtered poultry birds and pigs, and then minced using a mincer with a pore size of 10mm. The minced chicken meat and pork were analyzed for physico-chemical, microbiological and sensory parameters at ambient temperature for hourly interval. The results indicated a significant increase in pH, tyrosine value, TBARS values, weight loss and microbial profiles (Total plate count, Yeast and mould count, and Coliform count), and also a significant decrease in ERV and sensory (appearance, texture, odour and overall acceptability) scores of both minced chicken meat and pork with increase in storage period. Hence, it can be concluded that the shelf life of minced chicken meat and pork at ambient temperature was 3 hours and 6 hours respectively.

Keywords: *Ecosystem, Producing, Tissue, Chicken and Temperature.*

INTRODUCTION

Food is a complex, dynamic ecosystem, in which every component is continuously changing. It is essential to recognize these changes to minimize unwanted development, such as food spoilage, which is a naturally occurring process (Gram *et al.,* 2002). Meat is a highly demanded food item due to the presence of plentiful proteins, minerals and all the B-complex vitamins with excellent digestibility and a well-balanced composition of essential amino acids (Lawrie and Ledward, 2014). India is the most populous country with 140.76 crore population and stands at 8th place in meat production in the world and meat consumption and its prosperity raises along with the population. The total meat production in India is 9.29 million tonnes for the year 2021-22 with an annual growth rate of 5.62%. The meat production from poultry and pigs contributed 51.44% and 3.93% of total meat production (BAHS, 2022).

To meet a country's raising population and its nutritional security meat plays a pivotal role in country's food basket. Producing and processing meat in a

hygienic environment is a prerequisite for quality meat production. Ensuring the availability of safe meat to consumers in this vast country is a challenge (FAO, 2011). The structure of meat industry is highly unorganized in India (Kochewad *et al.,* 2017). The unregulated meat markets, tropical climate (hot and humid conditions), inadequate abattoir hygiene measures and the absence of surveillance of meat-borne diseases enhances the risk of meat-borne diseases and occupational hazards (Singh *et al.,* 2013).

Meat becomes more porous as a result of the mincing process, which damages fibrillar structures (myofibrils and connective tissue), tissue fluids are discharged, and minced meat provides a very nourishing environment for bacterial development. Minced meat is considered as an extremely perishable food since it greatly adds to meat decomposition by encouraging microbial growth to unacceptable levels, rendering it unfit for human consumption (Dordevic *et al.,* 2019).

When meat is prepared into various delicacies, improper handling can endanger human health. Food handlers at restaurants, food courts, and households have not been certified to handle meat in its different forms. Therefore, it is necessary to identify the appropriate patterns of meat spoilage at both ambient and refrigerated temperatures pertaining to Indian conditions. To reduce losses in the meat trade, it is essential to scientifically record all methods and processes of meat deterioration. This will not only protect meat traders from losses but also ensure consumer safety by providing the precise hourly shelf life of meat at ambient and chilling temperatures.

With the use of this fundamental knowledge, a scientific study has been designed in order to study the storage stability of minced chicken meat and pork at ambient temperature at hourly intervals.

METHODOLOGY

In the present study, the chicken meat and pork required for the experiment was procured hygienically from scientifically slaughtered chickens and pigs was minced using a meat mincer (Sirman TC12E) with a pore size of 10mm. Then the minced meat was packed in an aseptic container. The minced meat samples were analyzed for various physico-chemical parameters like pH (Troutt *et al*., 1992), ERV (Pearson, 1968), weight loss (Duun and Rustad, 2008), Tyrosine content (Strange *et al.,* 1977), lipid oxidation (Witte *et al.,* 1970), microbiological profiles (APHA, 2007) and sensory evaluation (Keeton, 1983), a one hour interval under ambient temperature.

RESULTS AND DISCUSSION

The results for the physicochemical, microbiological and sensory characteristics of hygienically procured and minced chicken meat and pork were analyzed for every one hour interval at ambient temperature and were presented in tables no1, 2, 3, 4, 5 and 6.

Physicochemical parameters

The pH refers to the level of acidity or alkalinity in meat, and it plays a crucial role in determining the quality of the meat. The pH of minced chicken meat and pork stored at ambient temperature was significantly ($p<0.05$) increased upto spoilage respectively. The results are in agreement with the findings of Kuswandi et al., (2014) in broiler chicken meat stored in both ambient and chiller conditions and Koutsoumanis *et al.,* (2006) in ground pork at 20°C temperature respectively, because of meat protein degradation results in the buildup of volatile amines and ammonia by bacteria, resulting in a significant rise in pH with an increase in storage period (Qiao *et al.,* 2002).

Extract release volume is a factor in predicting the shelf life of meat as well as identifying whether it has spoiled. The ERV of minced chicken meat and pork stored at ambient temperature was significantly **($p<0.05$)** decreased upto spoilage respectively. The results are in agreement with the findings of Jogdand *et al.,* (2023) in Emu meat at ambient temperature and Sadakuzzaman *et al.,* (2021) in beef at ambient temperature and concluded that a gradual increase in microbial growth during storage may be the cause of the ERV value decrease respectively.

Weight loss during storage is associated with water loss, which affects both the quality and yield of fresh and cooked meat. The weight loss in minced chicken meat and pork stored at ambient temperature was significantly ($p<0.05$) increased upto spoilage respectively. The results are in accordance with Garavito *et al.,* (2020) fresh chicken breast fillets in cold storage and Kaale *et al.,* (2014) in Atlantic Salmon under super chilling conditions respectively. These losses influence the flavor, texture and appearance of fresh meat, and the liquid exudate is an excellent nutritive source for bacteria growth (Duun and Rustad, 2008).

Tyrosine value is an indicator of proteolysis. The tyrosine value in minced chicken meat and pork stored at ambient temperature was significantly ($p<0.05$) increased upto spoilage respectively but there was no significant ($p<0.05$) difference between the 0th and 1st hour in pork. The results showed a positive correlation with the findings of

Kumar *et al.,* (2011) in spent hen meal at ambient temperature and Anagha *et al.,* (2023) in traditional Kerala product Kozhi ada (broiler meat product) at ambient temperature respectively. The denaturation of proteins in meat could be measured as tyrosine value which actually determined the quantity of amino acid tyrosine and tryptophan present in an extract of meat (Indumathi *et al.,* 2011).

Thiobarbituric acid reacting substances (TBARS) analysis measures the formation of secondary products of lipid oxidation such as malondialdehyde (MDA). The TBARS value in minced chicken meat and pork stored at ambient temperature was significantly increased upto spoilage respectively. The results showed a positive correlation with the findings of Jogdand *et al.,* (2023) in Emu meat at ambient temperature and Sadakuzzaman *et al.,* (2021) at beef at ambient temperature respectively. The increase in TBARS values may be due to the oxidation of fatty acids during the storage.

Microbiological parameters:

The total plate count, yeast and mould count, and coliform count in minced chicken meat and pork stored at ambient temperature were significantly **(p<0.05)** increased upto spoilage respectively. Similar results were reported in Emu meat (Jogdand *et al.,* 2023) as well as in beef (Sadakuzzaman *et al.,* 2021). Nevertheless, T-V-C values were reported to be higher than 6 log10CFU/g in spoiled pork (Zhao et al 2022)

Table 1: Mean ± S.E values for physico-chemical parameters of minced chicken meat at ambient temperature

parameters	pH	ERV (ml)	Weight loss (%)	Tyrosine (mg/100g)	TBARS (mg MDA/kg)
0hr	5.53±0.008^{a}	38.93±0.096^{e}	0.00±0.00^{a}	3.57±0.554^{a}	0.192±0.001^{a}
1st hr	5.72±0.011^{b}	36.34±0.329^{d}	1.32±0.042^{b}	4.48±1.264^{b}	0.230±0.004^{b}
2nd hr	5.82±0.006^{c}	27.53±0.568^{c}	1.79±0.033^{c}	5.46±0.269^{c}	0.361±0.003^{c}
3rd hr	5.91±0.007^{d}	21.20±0.365^{b}	3.64±0.287^{d}	8.02±0.246^{d}	0.498±0.004^{d}
4th hr	5.99±0.005^{e}	15.00±0.537^{a}	5.81±0.057^{e}	11.63±0.434^{e}	0.594±0.005^{e}

Mean values with different superscripts within columns differ significantly (p<0.05).

Mean is an average of twelve replications.

Table 2: Mean ± S.E values for physico-chemical parameters of minced pork at ambient temperature

Parameters	pH	ERV (ml)	Weight loss (%)	Tyrosine (mg/100g)	TBARS (mg MDA/kg)
0th hr	5.51±0.004^{a}	38.57±0.289^{h}	0.00±0.00^{a}	3.77±0.229^{a}	0.113±0.001^{a}
1st hr	5.55±0.002^{b}	35.99±0.158^{g}	1.63±0.093^{b}	4.55±0.498^{a}	0.194±0.001^{b}
2nd hr	5.58±0.003^{c}	33.95±0.170^{f}	2.68±0.102^{c}	6.01±0.332^{b}	0.264±0.001^{c}
3rd hr	5.62±0.004^{d}	31.37±0.266^{e}	4.22±0.140^{d}	7.53±0.245^{c}	0.321±0.002^{d}
4th hr	5.68±0.004^{e}	28.37±0.283^{d}	6.18±0.138^{e}	8.71±0.422^{d}	0.397±0.001^{e}
5th hr	5.76±0.008^{f}	23.09±0.535^{c}	7.33±0.095^{f}	10.37±0.841^{e}	0.471±0.002^{f}
6th hr	5.90±0.016^{g}	18.78±0.334^{b}	8.70±0.104^{g}	12.71±0.694^{f}	0.557±0.002^{g}
7th hr	6.01±0.006^{h}	15.30±0.253^{a}	9.69±0.117^{h}	13.64±0.350^{g}	0.625±0.003^{h}

Mean values with different superscripts within columns differ significantly (p<0.05).

Mean is an average of twelve replications.

Table 3: Mean ± S.E values for microbiological parameters of minced chicken meat at ambient temperature

Parameters	Total plate count (log_{10} CFU/g)	Yeast and mould count (log_{10} CFU/g)	Coliform count (log_{10} CFU/g)
0th hr	1.48±0.051[a]	1.45±0.073[a]	1.68±0.026[a]
1st hr	2.60±0.110[b]	2.42±0.069[b]	2.33±0.017[b]
2nd hr	4.28±0.034[c]	3.66±0.071[c]	2.87±0.012[c]
3rd hr	6.90±0.008[d]	4.50±0.010[d]	3.59±0.019[d]
4th hr	7.93±0.005[e]	5.13±0.005[e]	4.17±0.010[e]

Mean values with different superscripts within columns differ significantly (p<0.05).

Mean is an average of twelve replications.

Table 4: Mean ± S.E values for microbiological parameters of minced pork at ambient temperature

Parameters	Total plate count (log_{10} CFU/g)	Yeast and mould count (log_{10} CFU/g)	Coliform count (log_{10} CFU/g)
0th hr	1.43±0.034[a]	1.27±0.048[a]	1.01±0.010[a]
1st hr	2.08±0.021[b]	1.98±0.010[b]	1.55±0.014[b]
2nd hr	2.79±0.019[c]	2.50±0.021[c]	1.97±0.007[c]
3rd hr	3.58±0.052[d]	2.98±0.026[d]	2.35±0.012[d]
4th hr	4.62±0.032[e]	3.44±0.029[e]	2.77±0.014[e]
5th hr	5.61±0.010[f]	3.79±0.033[f]	3.38±0.084[f]
6th hr	6.81±0.021[g]	4.60±0.021[g]	3.88±0.016[g]
7th hr	7.89±0.012[h]	5.25±0.011[h]	4.50±0.023[h]

Mean values with different superscripts within columns differ significantly (p<0.05).

Mean is an average of twelve replications.

Table 5: Mean ± S.E values for sensory parameters of minced chicken meat at ambient temperature

Parameters	Appearance	Texture	odour	Overall acceptability
0th hr	7.89±0.028[e]	7.91±0.026[e]	7.91±0.029[e]	7.73±0.062[e]
1st hr	7.09±0.017[d]	7.33±0.026[d]	6.97±0.049[d]	6.98±0.022[d]
2nd hr	6.39±0.034[c]	6.51±0.023[c]	5.78±0.026[c]	5.98±0.076[c]
3rd hr	5.81±0.078[b]	5.28±0.021[b]	4.56±0.062[b]	4.95±0.010[b]
4th hr	4.32±0.081[a]	4.10±0.023[a]	3.72±0.079[a]	3.13±0.077[a]

Mean values with different superscripts within columns differ significantly (p<0.05).

Mean is an average of twelve replications.

Sensory evaluation

The sensory (appearance, texture, odour and overall acceptability) scores in both minced chicken meat and pork was significantly (p<0.05) decreased upto spoilage at ambient temperature. The results were in agreement with the findings of Anandh and Sobana, 2020 in turkey meat pickle at ambient temperature and Biswas *et al.,* (2011) in duck patties stored at ambient and refrigeration temperature respectively.

Table 6: Mean ± S.E values for Sensory parameters of minced pork at ambient temperature

Parameters	Appearance	Texture	odour	Overall acceptability
0th hr	7.97±0.009^{h}	7.86±0.019^{h}	7.86±0.009^{h}	8.00±0.00^{h}
1st hr	7.62±0.010^{g}	7.49±0.011^{g}	7.39±0.010^{g}	7.75±0.016^{g}
2nd hr	7.13±0.011^{f}	7.06±0.015^{f}	6.99±0.011^{f}	7.34±0.011^{f}
3rd hr	6.73±0.002^{e}	6.73±0.012^{e}	6.67±0.012^{e}	6.90±0.008^{e}
4th hr	6.25±0.002^{d}	6.28±0.020^{d}	6.15±0.005^{d}	6.52±0.009^{d}
5th hr	5.96±0.016^{c}	5.88±0.022^{c}	5.79±0.005^{c}	5.92±0.003^{c}
6th hr	5.14±0.009^{b}	5.38±0.024^{b}	4.40±0.004^{b}	4.67±0.010^{b}
7th hr	4.57±0.005^{a}	4.24±0.025^{a}	3.80±0.008^{a}	3.51±0.020^{a}

Mean values with different superscripts within columns differ significantly ($p<0.05$).

Mean is an average of twelve replications.

CONCLUSION

With the above research findings, it was found that the minced chicken meat and pork at ambient temperature were found to be sensorily acceptable and microbiologically safe upto 3 hours and 6 hours respectively. The minced meat was highly susceptible to both microbial growth and lipid oxidation because of their large surface to weight ratio, leading to rapid spoilage and development of rancid or warmed over flavour respectively. Hence the findings of the study will supplement the food processors and consumers to handle the minced meat in a safe and appropriate manner.

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