International Journal of Meat Science

ISSN 2071-7113

science alert

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International Journal of Meat Science 2 (1): 1-6, 2012
ISSN 2071-7113 / DOI: 10.3923/ijmeat.2012.1.6

Effects of Processing Practices on the Physico-chemical, Microbiological and Sensory Quality of Fresh Chicken Meat

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ABSTRACT

The present study was planned to find the differences in quality of fresh chicken obtained from different sources with different processing practices viz., market/road side chicken shop (MSC), Retail outlets (RSC) and semi automatic processing plant (Scientifically Slaughtered Chicken) (SSC). The sources of meat had no significant effect ($p<0.05$) on pH and tyrosine value of fresh chicken meat. However, SSC samples had significantly ($p<0.05$) higher water holding capacity, extract release volume and lower thiobarbituric acid value compared to other samples. Similarly, SSC samples harboured significantly ($p<0.05$) lower total viable count, coliform count, psychrophilic count and yeast and mould counts. Sensory evaluation of cooked samples did not reveal any difference in organoleptic attributes viz., appearance, flavour, juiciness and texture but overall palatability scores of SSC meat was significantly ($p<0.05$) higher than meat from other two sources. It was concluded that SSC meat was of better quality than MSC and RSC meat.

Key words: Fresh chicken, processing practices, physico-chemical, microbiological, sensory quality

INTRODUCTION

Rapid growth in consumer demand for poultry and poultry products over the last decade and increased international trade in these foods have focused attention on objective measures of food safety and quality. There is no specific policy regarding slaughter, dressing and sale of poultry meat in India. As a result roadside slaughter in most unhygienic manner is prevalent in most of the cities, towns and villages of India. Although a very few modern poultry processing plants have been established, majority of the consumers purchase meat from the roadside shops or small retailers where chickens are being slaughtered and dressed in unhygienic condition in their presence (Das and Biswas, 2003). But with the changing busy lifestyle of modern urban population, it is now becoming a common practice for many consumers to purchase branded meat and meat products from the refrigerated display cabinets of the super market which are mostly processed in modern meat processing plants. Therefore, there is a need to undertake a systematic study to evaluate quality differences in meat obtained from different sources of processing of ready-to-cook chicken. Keeping these points in view, the present work was carried out to compare the physico-chemical, microbiological and sensory qualities of chickens obtained from roadside shop, retail outlet and modern semi-automatic poultry processing plant.

MATERIALS AND METHODS

Sources of samples: This research work was carried out during the period of January to October, 2008. Chicken samples were collected from three different sources. First source of sample was road-side poultry meat shop. Usually, these shops are located road-side which does not have permanent shelters. All the operations are carried out manually. Mostly one single wooden block is used for all the dressing procedures. A bucketful of water is used for washing lot many carcasses by dipping in it. Such dressed chicken was designated as market/road-side slaughtered chicken (MSC). Second source of sample was retail outlet of poultry meat which was relatively better equipped than road-side poultry meat-shops. They have permanent shelter, bleeding cones, defeathering machine, separate slab for evisceration and dressing. They use relatively more water for washing of carcasses. These samples were designated as Retail Slaughtered Chicken (RSC). Third source of sample was scientifically/hygienically dressed broiler chickens obtained from semi-automatic poultry processing plant at the department of Livestock Products Technology, Rajiv Gandhi College of Veterinary and Animal Sciences which were slaughtered following standard procedures and were designated as Scientifically Slaughtered Chicken (SSC).

For each trial four dressed broilers from each source were collected in LDPE packages without any further contamination and transported to the laboratory maintaining cold chain. Breast portion was separated, halved longitudinally and subsequently cut into 5-6 cm^3 chunks by taking aseptic precautions. Breast chunks from each source were divided into different portions and were analyzed for following parameters.

Analysis of samples: The pH of the samples was determined following the method AOAC (1995) using a digital pH meter (Model LE 120, Elico); Water Holding Capacity (WHC) was examined by the method of Whiting and Jenkins (1981). Extract Release Volume (ERV) of meat samples was estimated according to the procedure described by Pearson (1968) with slight modification. Five grams of meat was blended with 20 mL distilled water for 2 min. Meat homogenate was transferred quantitatively into a funnel equipped with a Whatman filter paper No. 1 on a 100 mL measuring cylinder. The filtrate (mL) collected in first 15 min was recorded as ERV. TBA value of samples was determined following the extraction method described by Witte *et al.* (1970) and Tyrosine Value (TV) following the procedure of Strange *et al.* (1977). All the analyses were done in duplicate. Total Viable Count (TVC), Psychrophilic Count (PPC), coliform count and Yeast and Mould Count (YMC) were determined following procedures recommended by APHA (1984) after preparing serial dilution taking 10 g sample. Readymade media (Hi-Media Lab., Mumbai) such as plate count agar for SPC and PPC, violet red bile agar for coliform count and potato dextrose agar for YMC were used. Plates in duplicate were incubated at 37°C for 24-48 h for SPC and coliform count; 4±1°C for 10-14 days for PPC and at 25°C for YMC. After specific incubation periods plates showing 25-250 colonies were counted. The number of colonies were multiplied by the reciprocal of the respective dilution and expressed as $\log_{10}$ cfu g^{-1}.

For sensory evaluation, chicken breast chunks were marinated by addition of 1.5% salt (NaCl), 0.1% turmeric powder and 10% water for 10 min and pressure cooked at 1.1 kg cm^{-2} pressure for 10 min. Evaluation was carried out for organoleptic attributes viz., appearance, flavour, juiciness, texture and overall acceptability utilizing the services of semi-trained panelists adopting 8 point hedonic scale, where 8 denotes like extremely and 1 denotes dislike extremely.

A total of six trials were conducted. Data generated were pooled and analyzed following one way Analysis of Variance (ANOVA) and levels of significance were tested using the Least Significant Difference (LSD) test following Snedecor and Cochran (1989).

RESULTS

Results on physico-chemical properties of chicken meat obtained from different sources have been presented in Table 1. Perusal of results revealed that sources of chicken meat had no significant effects on pH of fresh chicken meat as MSC, RSC and SSC samples recorded pH values of 5.87 and 5.82 and 5.75, respectively.

The Water Holding Capacity (WHC) of the chicken samples ranged from 36.79 to 40.50% (Table 1). MSC samples (36.79) had significantly lower ($p<0.05$) WHC than RSC (39.89) and SSC samples (40.50), however there was no significant differences between RSC and SSC samples.

The ERV ranged from 13.00 to 15.34 mL. Significant ($p<0.05$) differences were observed in Extract Release Volume (ERV) of fresh chicken meat obtained from different sources. The ERV of SSC (15.34 mL) samples were significantly higher ($p<0.05$) compared to MSC (13.00 mL) and RSC (13.65 mL).

TBA value (Table 1) observed in the present study varied from 0.38-0.48 mg malonaldehyde/kg in fresh chicken meat. No significant differences were found among the samples in respect of TBA values. Tyrosine value ranged between 8.63-10.65 mg/100 g with SSC samples showing the lowest value.

In the present study, TVC of SSC samples (3.03 log cfu g^{-1}) were significantly lower ($p<0.05$) than MSC (6.28 log cfu g^{-1}) and RSC (6.23 log cfu g^{-1}) samples (Table 2). Psychrophilic count of MSC (6.71 log cfu g^{-1}), RSC (5.63 log cfu g^{-1}) and SSC (2.82 log cfu g^{-1}) samples were significantly ($p<0.05$) different from each other. Similar to TVC, coliform counts were significantly lower ($p<0.01$)

Table 1: Effect of different sources of processing of chicken on physico-chemical properties of chicken (Mean±SE)

Parameters	MSC	RSC	SSC
pH	5.87±0.04	5.82±0.5	5.75±0.05
WHC (%)	36.79±0.65^{a}	39.89±0.42^{b}	40.50±0.99^{b}
ERV (mL)	13.00±0.19^{a}	13.65±0.24^{b}	15.34±0.18^{c}
TBA value (mg malonaldehyde/kg)	0.48±0.02^{a}	0.42±0.03^{a}	0.38±0.02^{b}
TV (mg/100 g)	10.65±0.42	9.75±0.79	8.63±0.91

^{a,b,c}Means with different superscript in a row differ significantly ($p<0.05$). MSC: Market/ Road-side shop slaughtered chicken, RSC: Retail shop slaughtered chicken, SSC: Scientifically hygienically slaughtered chicken

Table 2: Effect of different sources of processing of chicken on microbiological and organoleptic qualities of chicken meat (Mean±SE)

	Sources of samples		
Parameters	MSC	RSC	SSC
Microbiological (log cfu g^{-1})			
TVC	6.28±0.16^{a}	6.23±0.10^{a}	3.03±0.16^{b}
Psychrophilic count	6.71±0.07^{a}	5.63±0.25^{b}	2.82±0.11^{c}
Coliform count	5.12±0.34^{a}	4.97±0.33^{a}	2.03±0.41^{b}
Yeast and mould	2.52±0.07^{a}	2.26±0.07^{b}	1.87±0.13^{b}
Organoleptic attributes			
Appearance	6.47±0.08	6.69±0.09	6.58±0.10
Flavor	6.50±0.09	6.72±0.10	6.58±0.14
Juiciness	6.53±0.13	6.67±0.12	6.61±0.12
Texture	6.44±0.11	6.68±0.10	6.72±0.13
Overall palatability	6.53±0.12^{a}	6.75±0.09^{a}	6.89±0.14^{b}

Means with different superscript in a row differ significantly ($p<0.05$). MSC: arket/Road-ide shop slaughtered chicken, RSC: Retail shop slaughtered chicken, SSC: Scientifically/hygienically slaughtered chicken

in SSC samples (2.03 log cfu g^{-1}) than MSC (5.12 log cfu g^{-1}) and RSC (4.97 log cfu g^{-1}) samples (Table 2). Yeast and mould count were also significantly ($p<0.01$) lower in SSC (1.87 log cfu g^{-1}) and RSC (2.26 log cfu g^{-1}) samples compared to MSC (2.52 log cfu g^{-1}).

The sensory scores pertaining to appearance, flavour, juiciness and texture of chicken meat samples obtained from three different sources did not show any significant differences and ranged between 6.44-6.72). However, the overall palatability score of SSC (6.89) samples was significantly ($p<0.05$) higher than MSC (6.53) and RSC (6.75) meat samples (Table 2).

DISCUSSION

The pH of different chicken samples recorded in the present study might be due to fall in pH because of anaerobic glycolysis as the gap between slaughter and pH analysis was almost 90-120 min. Almost similar observations on pH of poultry breast meat were also reported by Allen *et al.* (1997).

Better WHC of SSC chicken meat might be attributed to better slaughter practices. Similar value of WHC (40.26±2.09%) was reported by Mahajan *et al.* (2000) in broiler meat and by Pal *et al.* (2003) in the meat of Vanaraja birds. Significant ($p<0.05$) differences were observed in Extract Release Volume (ERV) of fresh chicken meat obtained from different sources. SSC samples exhibited significantly higher ($p<0.05$) ERV (15.34 mL) indicating better quality meat compared to meat from other two sources. Almost similar results were recorded by Sinhamahapatra *et al.* (2004) with mean values of 17.75 mL in fresh chicken meat.

The TBA value is estimated as a measure of lipid oxidation in muscle foods. The TBA results were in agreement with those of Ang and Lyon (1990) who reported TBA values ranging from 0.25-0.63 mg malonaldehyde/kg in cooked broiler muscles. Tyrosine Value (TV) is measured as quality indicator of muscle foods. The TV in the present study ranged from 8.63-10.65 mg/100 g (Table 1). Agnihotri (1988) reported a mean TV of 37.0 mg/100 g where as Daly *et al.* (1976) and Strange *et al.* (1977) recorded TV in the range of 26.0-66.0 mg/100 g in fresh beef. These variations in TV might be due to differences in the spices of animals and also due to different handling conditions of meat of different species.

Safety and keeping quality of meat and meat products primarily depend upon its microbial load and the conditions of storage. The lower microbial load in SSC samples could be attributed to high standards of hygienic practices in the slaughtering and dressing of chickens from where SSC samples were collected. Similarly, lower bacterial counts (log 3.8-5.5 cfu g^{-1}) and coliform counts of log 2.21 cfu g^{-1} in fresh chicken meat processed following standard procedures were reported by Al-Mohizea *et al.* (1994). On the other hand, higher microbial load in MSC and RSC samples might be due to unhygienic practices in slaughtering and dressing of chicken. These unhygienic practices included unscientific bleeding and scalding, non observance of precautions during evisceration to avoid fecal contamination and above all, use of contaminated water for washing of carcasses. Barbudhe *et al.* (2003) recorded high mesophilic (log 7.24 cfu g^{-1}) and yeast and mould counts (log 6.86 cfu g^{-1}) in poultry meat sold in Goa. Similarly, high microbial counts of log 7.61, 5.85 and 7.10 cfu g^{-1} for APC, coliform and YMC were reported in fresh chicken meat obtained from retail outlets of Pondicherry (Mukhopadhyay *et al.*, 2004) which were in close agreement with the findings of the present study.

The scores for all the sensory attributes ranged from 'like moderately' to 'like very much' for all the samples. This might be due to similar marination with 1.5, 0.1 and 10% salt, turmeric powder and water, respectively and similar cooking process applied to all the samples before serving to the

panelists for organoleptic evaluation. Salama (1993) and Sinhamahapatra *et al.* (2004) reported no significant differences in appearance, smell, tenderness and overall palatability of cooked chicken samples pre-marinated with 1.5% sodium, chloride.

From the results of the study it could be concluded that Scientifically Slaughtered Chickens (SSC) had better physico-chemical, microbial and organoleptic qualities than market/roadside slaughtered (MSC) and Retail Slaughtered Chickens (RSC).

ACKNOWLEDGMENTS

The authors thank the Dean, Rajiv Gandhi College of Veterinary and Animal Sciences, Pondicherry, India for providing necessary facilities to carry out the work.

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