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PHYSICO CHEMICAL PROPERTIES OF CHICKEN MEAT STORED IN ECOFRIENDLY PACKAGING MATERIALS.

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ABSTRACT

The aim was to evaluate the Physico chemical properties of chicken meat stored in ecofriendly packaging materials at refrigeration temperature of at 4 ± 1^{0}C. Ecofriendly packaging materials are prepared in Department of Meat Science and Technology, Madras Veterinary College with dies especially designed for this study purpose. Chicken drumsticks were packed in ecofriendly packaging materials viz. Areca Sheath trays (T1) Coconut shell trays (T2) and commercially available Styrofoam trays (control) to evaluate the physico-chemical properties such as pH, ERV (Extract release volume), WHC (Water holding capacity) at 0, 1, 3 and 5 days interval. The analysis of variance revealed a significant ($p<0.05$) increase in pH and significant ($p<0.05$) decrease in ERV and WHC with increase in storage period irrespective of packaging materials. Coconut shell powder trays and Styrofoam trays were evenly good enough to store chicken drumsticks at 4 ± 1º C until 3 days.

Keywords: Ecofriendly packaging, Chicken meat, Physico chemical properties..

INTRODUCTION

Packaging protects fresh meat from loss of moisture, contamination from microorganisms, changes in colour and physical damage. It also imparts attractiveness to the product. Commercially available packaging materials for fresh meat packaging in the market are Low-density polyethylene, High-density polyethylene, Polypropylene, Polyamide, Polyesters, polystyrene, polyethylene, Polyvinylidene chloride, and polyvinyl chloride which are potent source of environmental pollution. Chun.K.S, (2012) prepared coconut shell powder filled polylactic acid biocomposites by mixing Polylactic acid (PLA) matrix with untreated coconut shell powder or 3- aminoprpyltriethoxysilane treated coconut shell powder using Brabender Plastograph EC plus mixer at a temperature of 180ºC and a rotor speed of 50 rpm. Ramani. R., (2013) stated that the mean water holding capacity (cm^2) of 15 and 18 months old emu breast

muscle was 1.41 ± 0.02 cm^2 and 1.51 ± 0.3 cm^2 respectively. Moran. (2012) evaluated the effect of carnosic acid supplementation at 0.12% rates on lamb meat quality attributes stored at 4ºC and observed that Extract release volume reduced with increase of storage period from 36.5 ± 3.42 and on day 0 to 18.6 ± 3.66 on day 14 in lamb meat. In order to surmount the ill effects of petroleum based polymers, development of ecofriendly packaging materials is the need of the hour. Hence the present study was undertaken to evaluate the Physico chemical properties of chicken meat stored in ecofriendly packaging materials at refrigeration temperature of at 4 ± 1^0C utilizing Coconut shell powder and Areca sheath trays in comparison with commercially available Styrofoam trays.

Materials and Methods

Place of work

A study was conducted to evaluate the Physico chemical properties of chicken meat stored in ecofriendly packaging materials at refrigeration temperature of at 4 ± 1^0C. The shelf life of chicken meat stored in different packaging materials was assessed in the Department of Meat Science and Technology, Madras Veterinary College, Chennai-7.

Preparation of Areca sheath trays

The Areca sheath trays were prepared by immersing the areca sheath in cold water for about 20 minutes and then thoroughly cleaned and dried. The trays were prepared by applying pressure for 30 seconds over the cleaned dust free Areca sheaths using electrically operated aluminum die. The edges of trays were smoothened by using grinding machine. Then the trays were exposed to UV rays for 5 minutes for sterilization. The trays were painted with molted paraffin wax to provide a thin layer coating to avoid seepage of chicken meat exudates into the trays.

Preparation of Coconut shell powder trays

The coconut shell powder trays were prepared by blending coconut shell powder with Acacia gum powder to make a paste and then pressed to the desirable tray shape by using steel mould developed for the purpose. The trays are dried for 8 hours in sun. The plates were coated with molted paraffin wax to provide a thin layer coating to avoid oozing out or seepage of chicken meat stored. Later the trays were exposed to UV rays for 5 minutes for sterilization.

Analytical procedures

pH

The pH of chicken meat sample was measured using a digital pH meter (Digisun Electronic System, Model: 2001) as per the method outlined by Troutt *et al* (1992). About Five grams of meat sample was homogenized with 45 ml of distilled water in a laboratory blender for

about one minute. The pH was recorded by immersing the combination glass electrode in the homogenate. The pH meter was precalibrated using standard solutions with pH 4.0, 7.0 and 10.0 as per the user manual instructions.

Water holding capacity (WHC)

Water holding capacity of the chicken meat sample was assessed by adopting the filter paper press method recommended by Grau and Hamm (1953) with certain modifications. Approximately 300 mg of muscle tissue was kept in between a folded Whatman No. 41 filter paper. Two glass slides were kept one below and one above the folded filter paper. The muscle tissue was subjected to a downward pressure force by keeping a 100g weight on the top of the glass slide for 3 minutes. The entire process was carried out on a hard top table. The area of the two resultant impressions left on each half of the filter paper on account of the force was measured using a digital planimeter Model: KP – 90 N (PLACOM) and expressed in square centimeters.

Water holding capacity (%) = Inner area / Outer area × 100

Inner area is the impression of meat and the outer area is impression of the meat exudates absorbed by the filter paper.

Extract release volume (ERV)

The extract release volume of meat samples were determined by the modified method of Pearson (1968). Fifteen grams of fresh meat sample was blended with 60 ml of extraction reagent for two minutes in a laboratory blender. The extraction reagent with a pH of 5.8 was prepared by mixing 50 ml of 0.2 M potassium dihydrogen orthophosphate and 3.72 ml of 0.2 M sodium hydroxide and the volume was made up to 200 ml with distilled water. The blended contents are quantitatively transferred to a glass funnel (10 cm diameter) containing Whatman No.1 filter paper (18.5 cm diameter) folded thrice so as to make 8 sectors and the volume of the filtrate was collected in a 100 ml measuring cylinder. The volume of filtrate collected after 15 minutes at a temperature of 20°C was reported as extract release volume of the sample in ml.

Fresh chicken drumstick parts were bought from local meat market in Vepery and brought hygienically to the Department of Meat Science and Technology. The trays used for packaging of meat are initially kept in UV chamber for 20 minutes for sterilization. The chicken drumsticks were packed in different packaging materials viz, Areca sheath trays (T_1) coconut shell powder trays (T_2) and Styrofoam trays (control) and covered with cling wrap on top and then stored at a temperature of 4 ± 1ºC in refrigerator. The Areca sheath trays and coconut shell powder trays were coated with edible paraffin wax prior to sterilization. The physico-chemical characteristics such as pH, Extract release volume and Water holding capacity were assessed and

recorded at 0, 1, 3 and 5 days interval. The data collected were subjected to statistical analysis in SPSS software as per the standard procedure outlined by Snedecor and Cochran (1994).

Results and Discussion

pH

The analysis of variance revealed a significant ($p<0.05$) difference in pH values between different packaging materials, storage periods and interaction between treatment and days (Table 1). The initial pH of chicken drumsticks on day 0 in the present day was 6.69 ± 0.07 and was similar to the findings of Shawkat Ali *et al.* (2007) who observed that fresh chicken breast muscle had a pH of 6.7 at 15 min of postmortem. The pH of the samples increased with increase in storage period irrespective of packaging materials with higher values were recorded for the chicken drumstics packed in Areca sheath, which could be attributed to higher bacterial load compared to other packaging material.

The results are in agreement with the Surmei *et al.* (2013), who concluded that during longer storage, the meat suffers severe changes in terms of quality, one of which is increased pH. They also stated that chicken meat is considered to have a very good quality at a pH of 6.2 and when pH value is higher than 6.7 upon storage meat becomes uneatable. Surumei *et al.* (2012) also reported that meat is considered to have a very good quality at a pH of 6.2; when pH value is higher than 6.7 meats become unfit for consumption

Table 1. Mean ± SE values of pH of chicken drumsticks packed in different packaging materials and stored at 4 ± 1°C

pH	Days	Areca sheath tray	Coconut shell powder tray	Styrofoam tray	Overall mean Storage Period
	Day 0	6.69 ± 0.07^{aA}	6.69 ± 0.07^{aA}	6.69 ± 0.07^{aA}	6.69 ± 0.01^{W}
	Day 1	6.33 ± 0.03^{bB}	6.19 ± 0.04^{aB}	6.33 ± 0.03^{bB}	6.28 ± 0.02^{X}
	Day 3	6.55 ± 0.02^{aC}	6.41 ± 0.01^{bC}	6.43 ± 0.01^{bC}	6.46 ± 0.02^{Y}
	Day 5	6.70 ± 0.02^{aA}	6.51 ± 0.01^{bD}	6.58 ± 0.02^{cD}	6.59 ± 0.02^{Z}
	Over all mean Treatment	6.56 ± 0.01^{X}	6.45 ± 0.01^{Y}	6.50 ± 0.01^{Z}	

Means bearing different superscript between columns (a, b, c) between rows (A, B, C) and between overall mean (X, Y, Z) differ significantly ($p<0.05$) or ($p<0.01$).

Water Holding Capacity (WHC) (cm^2)

Water holding capacity is the ability of meat to hold its own or added water during application of any force. The water holding capacity is inversely proportionate to the area recorded from the filter paper in cm^2 and higher the value, lower the water holding capacity. In the present study a significant difference ($p<0.05$) was observed in WHC between different packaging materials, storage periods and interaction between storage and treatment (Table 2). The WHC of chicken drumsticks decreased with increase in storage period irrespective of packaging materials. The results of the study were in concurrence with Sinhamahapatra *et al*. (2004), who observed that decrease in water holding capacity of chicken meat during refrigerated storage.

Table 2. Mean ± SE values of Water holding capacity of chicken drumsticks packed in different packaging materials and stored at 4 ± 1ºC

WHC	Days	Areca sheath tray	Coconut shell powder tray	Styrofoam tray	Overall mean Storage Period
	Day 0	1.09 ± 0.03^{aA}	1.09 ± 0.03^{aA}	1.09 ± 0.03^{aA}	1.09 ± 0.02^{X}
	Day 1	1.14 ± 0.04^{aA}	1.14 ± 0.02^{aA}	1.21 ± 0.03^{aA}	1.17 ± 0.02^{X}
	Day 3	1.50 ± 0.06^{abB}	1.34 ± 0.02^{aB}	1.64 ± 0.07^{bB}	1.49 ± 0.04^{Y}
	Day 5	2.31 ± 0.05^{abC}	2.12 ± 0.06^{aC}	2.14 ± 0.08^{bC}	2.28 ± 0.05^{Z}
	Over all mean Treatment	1.51 ± 0.02^{Z}	1.41 ± 0.02^{Y}	1.58 ± 0.02^{X}	

Means bearing different superscript between columns (a, b, c) between rows (A, B, C) and between overall mean (X, Y, Z) differ significantly ($p<0.05$) or ($p<0.01$).

Extract Release Volume (ERV) (ml)

The analysis of variance revealed a significant difference ($p<0.05$) in ERV between different packaging materials, storage periods and interaction between treatment and storage period (Table 3). There was a significant decrease in ERV with increase in storage period irrespective of packaging materials. Chicken meat packed in Areca sheath trays had lower ERV compared to other treatments. This could be attributed to the fact that the bacterial counts were higher in the meat stored in Areca sheath trays compared to other packaging materials.

The mean ± S.E values of ERV of chicken drumsticks packed and stored in Areca sheath trays, coconut shell powder trays and Styrofoam trays on day 5 are 9.50 ± 0.22, 13.83 ± 0.48 and 11.33 ± 0.49 respectively. The results of the study were in concurrence with Sinhamahapatra *et al.* (2004), who opined that ERV is an useful index to determine meat quality

during storage period and observed that ERV reduced significantly with increase in storage period in chicken meat, which was attributed to increase in bacterial population. The rapid spoilage of chicken meat packed in Areca sheath trays may be due to microbial spoilage.

Table 3. Mean ± SE values of Extract release volume of chicken drumsticks packed in different packaging materials and stored at 4 ± 1ºC

ERV	Days	Areca sheath tray	Coconut shell powder tray	Styrofoam tray	Overall mean Storage Period
	Day 0	22.67 ± 0.61^{aA}	22.67 ± 0.61^{aA}	22.67 ± 0.61^{aA}	22.67 ± 0.33^{Y}
	Day 1	18.17 ± 0.31^{aB}	19.50 ± 0.22^{bB}	19.17 ± 0.48^{abB}	18.94 ± 0.24^{X}
	Day 3	17.17 ± 0.31^{aB}	18.67 ± 0.21^{bB}	18.50 ± 0.22^{bB}	18.11 ± 0.21^{X}
	Day 5	9.50 ± 0.22^{aC}	13.83 ± 0.48^{bC}	11.33 ± 0.49^{cC}	11.56 ± 0.49^{Z}
	Over all mean Treatment	16.87 ± 0.21^{X}	18.66 ± 0.21^{Y}	17.91 ± 0.21^{Z}	

Means bearing different superscript between columns (a, b, c) between rows (A, B, C) and between overall mean (X, Y, Z) differ significantly ($p<0.05$) or ($p<0.01$).

Conclusion

The analysis of variance revealed a significant ($p<0.05$) increase in pH and significant ($p<0.05$) decrease in Extract release volume and Water holding capacity with increase in storage period irrespective of packaging materials. Based on the results of physico chemical properties, coconut shell powder trays and styrofoam trays were evenly good enough to store chicken drumsticks at 4 ± 1º C until 3 days. However, biodegradability, effective utilization of raw material for preparation of coconut shell powder and preclusion of environmental pollution makes it more superior than commercially available styrofoam trays for storage of chicken drumsticks.

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