

## QUALITY EVALUATION OF VACUUM PACKAGED RESTRUCTURED CHICKEN CHUNKS

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**Abstract:** Effects of packaging (aerobic and vacuum conditions) on physicochemical, microbiological and sensory properties in restructured chicken chunks were determined. The products were packaged vacuum and aerobically in low density polyethylene (LDPE) pouches and analyzed at regular interval of 7 days for 35 days during refrigerated storage ( $4\pm 1^\circ\text{C}$ ). Results revealed that the SPC, Coliforms, thiobarbituric acid-reactive substances (TBARS), pH and tyrosine values obtained were significantly ( $P < 0.05$ ) low in vacuum packaged restructured chicken chunks than aerobically packed and mean values were increased significantly ( $P < 0.05$ ) as refrigerated storage period advances in both control and treatment. Yeast & mould counts were not detected both in control and treatment during entire storage period. The sensory scores of treatment and control for appearance, flavour, tenderness, juiciness and overall acceptability showed a progressive decline with increase in storage period. The treatment retained good acceptability for 35 days without any marked loss of physico-chemical, microbiological and sensory quality, whereas control restructured chicken chunks which were packaged aerobically spoiled within 21 days of storage. Therefore, use vacuum packaging would be useful to control the oxidative quality changes of restructured chicken chunks.

**Keywords:** Restructured, Chicken, Quality, Vacuum packaging and evaluation.

### INTRODUCTION

Restructuring is the method in which meat is partially or completely disassembled and then reassembled and then reformed into same or different form. Restructured meat product has the advantages of convenience in preparation and economy in the production. During refrigeration, the vacuum allows the shelf life of the chicken to be extended by reducing oxidation and the growth of aerobic micro-organisms. Vacuum packaging has proven to be efficient in extending shelf life, preserving the sensory characteristics inherent to the product for a period sufficiently long for its turnover (Maria *et al.*, 2011). The shelf life of meat products can be considerably extended by vacuum packaging in a film of low gas permeability (Pavankumar *et al.*, 2003). Due to paucity of information on effect of vacuum packaging on quality attributes and shelf life of chicken chunks stored under refrigeration, the present study was undertaken.

## OBJECTIVE OF THE PRESENT STUDY

To prepare and evaluate the physico-chemical, microbiological quality and acceptability of restructured chicken chunks in refrigerated storage ( $4 \pm 1^\circ\text{C}$ ) under vacuum packaging condition.

## MATERIALS AND METHODS

### Raw materials:

Spent hens of age 72 weeks were purchased from the local market and they were slaughtered conventionally in the slaughterhouse of Department of Livestock Products Technology, College of Veterinary Science, Tirupati and deboned manually to obtain bone less chicken meat. The skin, subcutaneous fat and connective tissue were trimmed off and the deboned chicken meat was used for further studies. Spices and condiments were cleaned thoroughly without any extraneous materials and were ground individually and sieved to obtain a fine powder. Spice mix was formulated and stored for subsequent use.

### Preparation of restructured chicken chunks:

Freshly deboned chicken pieces was first soaked in freshly prepared curing solution (Table-1) and kept at refrigeration temperature of ( $4 \pm 1^\circ\text{C}$ ) for 24 hours. On the next day the excess curing solution was drained off from the chicken pieces. Then the chicken pieces were restructured in a planetary mixture along with the addition of all other ingredients as per Table-2. Mixing was continued for 3 minutes. Then that meat was tightly stuffed and sealed in steel boxes without air locks and cooked in a steam oven without pressure for 45 min. The internal temperature of the cooked chicken blocks ( $70 \pm 1^\circ\text{C}$ ) was measured using thermometer. The meat blocks were cooled to room temperature and chilled overnight at  $4 \pm 1^\circ\text{C}$ . After 12 h of chilling the blocks were manually cut into chunks of thickness 1cm and packaged under vacuum in polyethylene ethylene pouches using a Roschermatic packaging machine (Model VM19S, Osnabrück, Germany) and the control chicken chunks were packaged by aerobic packaging for comparative study. Then the samples were kept at  $4 \pm 1^\circ\text{C}$  and examined at intervals of 7 days up to 35 days with the following parameters like Physico-chemical characteristics, Microbiological evaluation and Organoleptic evaluation

### Evaluation of Quality characteristics:

**pH:** pH of the preparation was estimated by following the method of Trout *et al.*, (1992) using digital pH meter (Oakton Instruments, USA).

**Thiobarbituric acid reactive substances (TBRAS) number :** The TBARS number (mg malonaldehyde/kg) of the vacuum packed restructured chicken chunks was determined using

the distillation method described by Witte *et al.*, (1970) The values were expressed as mg malonaldehyde/kg of sample.

**Tyrosine value:** Tyrosine value was estimated by procedure prescribed by Strange *et al.*, (1977).

**Microbiological examination:** For microbiological examination, a representative of 1 g restructured chicken chunk sample was withdrawn and homogenized in aseptically using 9 ml 0.1% peptone water (and serial dilutions were made using 0.1% sterile peptone water. The microbial quality of prepared were evaluated by estimating the Total plate count (TPC), Coliform Count (PPC) and Yeast and Mould counts(Y&M) following pour plating technique as per standard procedure of APHA (1984).

**Organoleptic evaluation:** The vacuum packed restructured chicken chunks along with control (aerobically packed) thus prepared as per the standardized formulations were shallow pan fried for 1 minutes and subjected to a 6 member taste panel including staff and students for sensory evaluation to evaluate color, flavor, juiciness, tenderness and overall acceptability on a 9 point hedonic scale.

## **RESULTS & DISCUSSION:**

**Physico-chemical parameters:** The results obtained for physico-chemical parameters of restructured chicken chunks were presented in Table 3. According to the results, there were ( $P < 0.51$ ) increased pH values as storage period advances in both the treatment (vacuum packaged) and control (aerobically packaged) and found that the mean pH values of treatment were increased about 0.11 units during 35 days of storage, where as it was increased by 0.19 units in control even in 21 days of storage. The rate of change in pH values during storage differ significantly ( $P < 0.05$ ) for the control and the treatment. The results of the present study were in agreement with the results reported by Malav *et al.*, (2013) in restructured chicken blocks; Mandal *et al.*, (2002) in restructured cured chicken; Debashis Bhattacharyya, *et al.*, (2013) in duck sausages; Naveena *et al.*, (2014) Emulsion Products from Chicken during refrigeration storage.

As per the results, the mean values of TBARS numbers during the storage period were below the minimum threshold value, i.e., 1-2 mg malonaldehyde/kg meat (Watts, 1962) and found that the TBARS values for treatment as well as control were increased significantly ( $P < 0.05$ ) throughout the storage period. TBARS values for treatment were significantly lower ( $P < 0.05$ ) than control throughout the storage period. The TBARS values increased sharply in aerobic packaging during storage than treatment, it might be due to vacuum-packaged meat

was more resistant to lipid oxidation and aerobically packed meat is susceptible to oxidative changes. This result agreed with Ahn *et al.*, (1998) who interpret as showing that storage condition or oxygen availability was more important for the development of lipid oxidation and Nam and Ahn (2003) found that the TBARS increase could be proportional to the exposure time to aerobic conditions. The present study was in coincides with Thomas *et al.*, (2006) in restructured buffalo meat nuggets; Yim *et al.*, (2015) in restructured chicken rolls and Deepshikha *et al.*,(2016) in vacuum packed ready-to-eat Vawksa rep.

The mean tyrosine values for treatment were significantly lower ( $P < 0.05$ ) than control throughout the storage period. The tyrosine values were of the treatment and control increased significantly ( $P < 0.05$ ) throughout the storage period which might be attributed to increased microbial proteolytic activity as evident from increased microbial counts during storage. The tyrosine value indicates presence of free amino acids which generally increases due to microbial protease activity. These results were in agreement with Anna Anandh. (2015) in buffalomeat rolls; Sudeer *et al.*, (2011) and Mandal *et al.*, (2002) in restructured chicken block during refrigerated storage.

**Microbial analysis:** The results of microbial parameters of restructured chicken chunks were presented in Table 4. Results revealed that, the mean standard plate counts of the treatment and control increased significantly ( $P < 0.05$ ) during refrigerated storage and also observed significant difference between control and treatment. The microbial counts recorded in the present study were in agreement with Bhojar *et al.*, (1997) and Mandal *et al.*, (2002). The coli form counts were observed from 7<sup>th</sup> day of storage and the counts were increased ( $P < 0.05$ ) as storage period advances in both control and treatment. Yeast & moulds were not detected in the product throughout the storage period. Similar results were found by Anna Anandh (2015) in vacuum packed buffalo meat rolls ; Pal *et al.* (2003) in chicken sausages, Sachdev and Gopal (2000) in cooked chicken rolls; Sudeer *et al.*, (2011) and Najeeb *et al.*, (2014) in restructured chicken block and during refrigerated storage.

**Sensory evaluation:** Mean sensory score of treatment and control restructured chicken chunks were presented in Table 5. The mean sensory scores of control differed significantly ( $P < 0.05$ ) with the treatment during storage. This might be due to the surface dehydration of products in aerobic packaging. The sensory scores of both treatment and control showed a progressive significant decline ( $P < 0.05$ ) with increase in storage period. Decline in sensory scores during storage could be due to increase in TBARS number and free fatty acids in the meat products (Tarladgis *et al.*, 1960) under storage conditions. The results were correlated

with Anna Anandh (2015) in vacuum packed buffalo meat rolls; Sudeer *et al.*, (2011) and Najeeb *et al.*, (2014) in restructured chicken block and during refrigerated storage.

### Conclusion

Based on the above results, it can be concluded that vacuum packaging had definite advantage in preserving the physico chemical, sensory and microbial quality of restructured chicken chunks. The restructured chicken chunks had better acceptability up to 35 days of storage at  $4 \pm 1^{\circ}\text{C}$  in PE pouches under vacuum packaging, whereas control restructured chicken chunks which were packaged aerobically spoiled within 21 days of storage.

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**Table 1:** Curing solution composition:

S.No.	Ingredient	Percentage
1.	Salt	3.2%
2.	Phosphate	0.4%
3.	Nitrate	0.02%
4.	Sugar	1%

**Table 2:** Formulation of restructured chicken chunks:

S.No.	Ingredient	Percentage
1.	Deboned chicken chunks	95.5%
2.	Binder(Maida)	1%
3.	Wet condiment mix	2.5%
4.	Dry spice mix	1%

**Table 3:** Physicochemical characteristics of Vacuum packaged restructured chicken chunks stored at refrigeration ( $4 \pm 1^\circ\text{C}$ ) temperature. (Mean $\pm$ S.E)

Treatment	Days of storage at refrigeration temperature ( $4 \pm 1^\circ\text{C}$ )						Overall mean
	0	7	14	21	28	35	
<b>pH (%)</b>							
Control (A.P)	6.23 $\pm$ 0.032	6.28 $\pm$ 0.015	6.32 $\pm$ 0.042	6.42 $\pm$ 0.045	Spoiled	Spoiled	6.31 $\pm$ 0.025 <sup>A</sup>
Treatment (V.P)	6.23 $\pm$ 0.025	6.28 $\pm$ 0.018	6.24 $\pm$ 0.012	6.29 $\pm$ 0.024	6.31 $\pm$ 0.016	6.34 $\pm$ 0.006	6.28 $\pm$ 0.025 <sup>B</sup>
<b>Overall mean</b>	6.23 $\pm$ 0.001 <sup>a</sup>	6.28 $\pm$ 0.005 <sup>a</sup>	6.28 $\pm$ 0.008 <sup>a</sup>	6.35 $\pm$ 0.006 <sup>b</sup>	-	-	
<b>TBARS value mg malonaldehyde/kg</b>							
Control (A.P)	0.17 $\pm$ 0.051	0.25 $\pm$ 0.031	0.46 $\pm$ 0.014	0.69 $\pm$ 0.008	Spoiled	Spoiled	0.39 $\pm$ 0.014 <sup>A</sup>
Treatment (V.P)	0.17 $\pm$ 0.021	0.19 $\pm$ 0.021	0.21 $\pm$ 0.019	0.29 $\pm$ 0.051	0.31 $\pm$ 0.020	0.36 $\pm$ 0.030	0.25 $\pm$ 0.052 <sup>B</sup>
<b>Overall mean</b>	0.17 $\pm$ 0.071 <sup>a</sup>	0.22 $\pm$ 0.080 <sup>b</sup>	0.33 $\pm$ 0.011 <sup>b</sup>	0.49 $\pm$ 0.025 <sup>c</sup>	-	-	-
<b>Tyrosine value</b>							
Control (A.P)	0.43 $\pm$ 0.011	0.68 $\pm$ 0.011	1.56 $\pm$ 0.005	1.96 $\pm$ 0.028	Spoiled	Spoiled	1.15 $\pm$ 0.025 <sup>A</sup>
Treatment (V.P)	0.42 $\pm$ 0.041	0.48 $\pm$ 0.021	0.51 $\pm$ 0.004	0.68 $\pm$ 0.037	0.71 $\pm$ 0.0041	0.89 $\pm$ 0.002	0.61 $\pm$ 0.025 <sup>B</sup>
<b>Overall mean</b>	0.42 $\pm$ 0.021 <sup>a</sup>	0.58 $\pm$ 0.015 <sup>a</sup>	1.03 $\pm$ 0.025 <sup>b</sup>	1.32 $\pm$ 0.005 <sup>b</sup>	-	-	

Means with different superscripts in a row and column wise differ significantly ( $P < 0.05$ ).

A.P- Aerobic packaging, V.P- Vacuum packaging

**Table: 4** Microbiological characteristics of Vacuum packaged restructured chicken chunks stored at refrigeration ( $4 \pm 1^\circ\text{C}$ ) temperature (Mean $\pm$ S.E)

Treatment	Days of storage at refrigeration temperature ( $4 \pm 1^\circ\text{C}$ )						
	0	7	14	21	28	35	Overall mean
<b>Standard Plate Count (log<sub>10</sub>cfu/g of meat)</b>							
Control (A.P)	1.97 $\pm$ 0.011	2.91 $\pm$ 0.051	3.81 $\pm$ 0.072	4.96 $\pm$ 0.062	Spoiled	Spoiled	3.41 $\pm$ 0.004 <sup>A</sup>
Treatment(V.P)	1.98 $\pm$ 0.051	2.24 $\pm$ 0.014	2.59 $\pm$ 0.033	3.24 $\pm$ 0.042	3.89 $\pm$ 0.009	4.99 $\pm$ 0.038	3.15 $\pm$ 0.013 <sup>B</sup>
Overall mean	1.97 $\pm$ 0.013 <sup>a</sup>	2.57 $\pm$ 0.011 <sup>b</sup>	3.20 $\pm$ 0.009 <sup>c</sup>	4.10 $\pm$ 0.014 <sup>d</sup>	-	-	
<b>Coliform count(log<sub>10</sub>cfu/g of meat)</b>							
Control (A.P)	ND	1.23 $\pm$ 0.008	1.41 $\pm$ 0.027	1.82 $\pm$ 0.041	Spoiled	Spoiled	1.48 $\pm$ 0.022 <sup>A</sup>
Treatment(V.P)	ND	0.81 $\pm$ 0.055	1.11 $\pm$ 0.019	1.24 $\pm$ 0.084	1.35 $\pm$ 0.066	1.57 $\pm$ 0.082	1.21 $\pm$ 0.072 <sup>B</sup>
Overall mean	-	1.02 $\pm$ 0.025 <sup>a</sup>	1.26 $\pm$ 0.025 <sup>b</sup>	1.53 $\pm$ 0.025 <sup>c</sup>	-	-	-
<b>Yeast and mould count(log<sub>10</sub>cfu/g of meat)</b>							
Control (A.P)	ND	ND	ND	ND	ND	ND	-
Treatment(V.P)	ND	ND	ND	ND	ND	ND	-
Overall mean	-	-	-	-	-	-	-

Means with different superscripts in a row and column wise differ significantly ( $P < 0.05$ ).

**Table 5:** Organoleptic characteristics of Vacuum packaged restructured chicken chunks stored at refrigeration ( $4 \pm 1^\circ\text{C}$ ) temperature (Mean $\pm$ S.E)

Treatment	Days of storage at refrigeration temperature ( $4 \pm 1^\circ\text{C}$ )						Overall mean
	0	7	14	21	28	35	
<b>APPEARANCE</b>							
Control (A.P)	7.91 $\pm$ 0.024	7.43 $\pm$ 0.001	7.13 $\pm$ 0.001	6.10 $\pm$ 0.071	Spoiled	Spoiled	7.14 $\pm$ 0.021 <sup>A</sup>
Treatment (V.P)	7.83 $\pm$ 0.041	7.54 $\pm$ 0.052	7.23 $\pm$ 0.019	7.14 $\pm$ 0.002	6.82 $\pm$ 0.051	6.25 $\pm$ 0.011	7.13 $\pm$ 0.032 <sup>A</sup>
Overall mean	7.87 $\pm$ 0.016 <sup>a</sup>	7.48 $\pm$ 0.011 <sup>a</sup>	7.18 $\pm$ 0.047 <sup>b</sup>	6.62 $\pm$ 0.071 <sup>c</sup>	-	-	-
<b>FLAVOUR</b>							
Control (A.P)	7.42 $\pm$ 0.091	7.65 $\pm$ 0.058	6.90 $\pm$ 0.002	5.14 $\pm$ 0.001	Spoiled	Spoiled	6.77 $\pm$ 0.001 <sup>A</sup>
Treatment (V.P)	7.51 $\pm$ 0.052	7.36 $\pm$ 0.015	7.18 $\pm$ 0.071	6.72 $\pm$ 0.062	6.14 $\pm$ 0.007	5.89 $\pm$ 0.022	6.80 $\pm$ 0.061 <sup>A</sup>
Overall mean	7.46 $\pm$ 0.011 <sup>a</sup>	7.50 $\pm$ 0.034 <sup>a</sup>	7.04 $\pm$ 0.014 <sup>b</sup>	5.93 $\pm$ 0.007 <sup>c</sup>	-	-	-
<b>JUICINESS</b>							
Control (A.P)	7.21 $\pm$ 0.041	7.24 $\pm$ 0.051	6.28 $\pm$ 0.006	5.35 $\pm$ 0.001	Spoiled	Spoiled	6.52 $\pm$ 0.012 <sup>A</sup>
Treatment (V.P)	7.25 $\pm$ 0.017	7.51 $\pm$ 0.081	7.10 $\pm$ 0.018	6.88 $\pm$ 0.080	6.59 $\pm$ 0.051	5.17 $\pm$ 0.012	6.75 $\pm$ 0.034 <sup>A</sup>
Overall mean	7.23 $\pm$ 0.025 <sup>a</sup>	7.37 $\pm$ 0.012 <sup>a</sup>	6.69 $\pm$ 0.025 <sup>b</sup>	6.11 $\pm$ 0.028 <sup>c</sup>	-	-	-
<b>TENDENESS</b>							
Control (A.P)	7.89 $\pm$ 0.051	7.51 $\pm$ 0.021	6.10 $\pm$ 0.009	5.48 $\pm$ 0.011	Spoiled	Spoiled	6.74 $\pm$ 0.022 <sup>A</sup>
Treatment (V.P)	7.78 $\pm$ 0.011	7.69 $\pm$ 0.010	7.48 $\pm$ 0.041	7.11 $\pm$ 0.018	6.38 $\pm$ 0.01	5.29 $\pm$ 0.017	6.95 $\pm$ 0.021 <sup>B</sup>
Overall mean	7.83 $\pm$ 0.031 <sup>a</sup>	7.60 $\pm$ 0.025 <sup>b</sup>	6.79 $\pm$ 0.052 <sup>c</sup>	6.29 $\pm$ 0.02 <sup>c</sup>	-	-	-
<b>OVERALL ACCEPTABILITY</b>							
Control (A.P)	7.94 $\pm$ 0.021	7.41 $\pm$ 0.011	6.52 $\pm$ 0.071	5.11 $\pm$ 0.091	spoiled	Spoiled	6.74 $\pm$ 0.042 <sup>A</sup>
Treatment (V.P)	7.89 $\pm$ 0.005	7.85 $\pm$ 0.013	7.48 $\pm$ 0.014	7.51 $\pm$ 0.008	6.78 $\pm$ 0.031	5.84 $\pm$ 0.023	7.22 $\pm$ 0.016 <sup>B</sup>
Overall mean	7.91 $\pm$ 0.035 <sup>a</sup>	7.63 $\pm$ 0.044 <sup>b</sup>	7.00 $\pm$ 0.04 <sup>c</sup>	6.31 $\pm$ 0.015 <sup>d</sup>	-	-	-

Means with different superscripts in a row and column wise differ significantly ( $P < 0.05$ ).