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# Study on effect on water activity, TBA number and protein of dried chicken meat during storage

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SUMMARY :

The present experiment was envisaged to evaluate the effect of packaging methods and treatments and storage time on protein content, TBA number and water activity of dried chicken meat throughout storage period. Dehydrated chicken meat with sodium nitrite treatment was prepared by high velocity hot air drying at temperature of 55°C and air velocity of 5.5 m/s. Protein content, TBA number and water activity were determined after 15 days interval during storage of 150 days. Effect of packaging methods and treatments and storage time of dried chicken meat observed significant ($P<0.05$) in all cases. Protein, TBA number and water activity of vacuum packaged sample were found significantly higher ($P<0.05$) than conventional packaged and sodium chloride plus sodium nitrite treated chicken meat (treated sample) were detected significantly higher ($P<0.05$) than sodium chloride treated only (raw sample). Protein content were found decreased both in vacuum as well as conventional packaged sample throughout storage but TBA number and water activity were found increased significantly ($P<0.05$) during storage in all cases. The dried chicken meat was acceptable at the 150 days of storage period.

**KEY WORDS :** Dried chicken meat, Water activity, TBA number, Protein content, Packaging methods

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Modern consumers are increasing preference for functional and healthy foods in their diet. The meat products consumption is increasing due to changes in lifestyle which need convenience in diet of people. India, similar to other developing countries has the demand of food for the increasing population which cannot be fulfilled by vegetable sources only. Thus, meat and meat products are gaining popularity to fulfill the demands of growing population. Meat is an important livestock food product which is in its widest sense includes all those parts of animal body that are used as food by man. Meat is an excellent source of high quality protein with all essential amino acids and it also contain large amount of minerals and essential vitamins. So chicken is

the most commonly recognized meat in India.Vacuum packaging is good preservation method, in which a pressure differential exists between the package exterior and interior. Pressure differential leads to package collapse of rigid packages, but is suitable for flexible packaging. The effects of nitrite, packaging methods and storage time on the chemical properties, TBA values and microbiological counts of dried meat product were determined. TBA values were not affected by nitrite of vacuum packaging but increased significantly with storage time (Davies *et al.*,1989).

Meat preservation is very important for delaying microbiological spoilage and avoiding quality deterioration during storage. Dried meat product produced by different processes stay of interest since they are doing not need refrigeration throughout distribution and storage. Dehydration principally place confidence in prolonging the keeping quality of the meat by reducing the water activity. Preservation methods include use of vacuum packaging, and chemical treatments are simple method for preserving quality of meat and meat. The Main objective of this work to study the effect of packaging methods, treatments and storage time on water activity, TBA number and protein content of dried chicken meat during storage period.

## EXPERIMENTAL METHODS

**Sample preparation :**

Chicken meat were procured from local market of pantnagar, U.S. Nagar U.K. Chicken breast was used for this study. Skin of chicken breast meat was first removed and cut flesh normal to muscle fibres into sample sizes of 1×1×1 cmusing a sharp knife.

**Treatments :**

Chicken meat samples were treated with a solution containing 3.5 per cent of sodium chloride only (raw sample) and other treated with solution of 3.5 per cent of sodium chloride plus 0.015 per cent of sodium nitrite. Chicken meat samples for both pre-treatments were dipping into solutions at 50°C for 10 minutes. The ratio of chicken meat to solution was 1:2 w/v. After pre-treatment, the chicken meat samples were removed from solution and spread on a screen to drain off the excess water. Pre-treatment was carried out to avoid microbial growth and undesirable quality changes during hot air drying and storage period.

**Drying :**

Both treated and raw samples dried at temperature of 55 ºC and air velocity of 5.5 m/s. using high velocity hot air dryer (Specification: motor capacity 1.5 kw, heater capacity 12 kw ,Timer 0-60 (10 min interval) temperature range 30-110 ºC) manufactured by Kilburn macneil and berry limited.

**Packaging methods :**

There were two packaging methods used for evaluation of qualities during storage. For vacuum packaging, dehydrated chicken meat samples were packed in polypropylene bags in Invac vacuum packaging machine (Saurabh Engineer Ahmadabad) under -700 mm Hg of vacuum pressure whereas hand operated portable sealing machine of 8 inch length was used for sealing the polypropylene bags. All packed samples of chicken meats were kept on metal racks at ambient temperature for storage and reopen after 15 days interval for quality evaluation during storage period.

**Quality evaluation of dehydrated chicken meat :**

*Protein content* :

The protein content was determined by micro-kjeldal method as given in AOAC (1984). Two gram chicken meat sample was taken in a digestion flask followed by addition of 3 g of sample of digestion mixture ($K_2SO_4$, $CuSO_4$, $SeO_2$ in 100:20:2.5 ratio) and 25 ml of conc. Sulphuric acid. The content were then digested till a blue/ green transparent liquid was obtained. The volume of digested mixture was made upto 100 ml with distilled water. A 20 ml aliquot of digested mixture was distilled with excess of 40 per cent NaOH solution and liberated ammonia was collected in 20 ml of 2 per cent boric acid solution containing 2 to 3 drops of mixed indicator (10 ml of 0.1% bromocresol green + 2 ml of 0.1 % methyl red indicator in 95% alcohol). The entrapped ammonia was titrated against 0.1 N HCl. A regent blank was similarly digested and distilled. Nitrogen content in sample was calculated as follows:

$$\%N_2 = \frac{\text{Sample titre} - \text{Blank titre} \times \text{Normality of HCl} \times 14 \times \text{Volume made up}}{\text{Aliquot of digest taken} \times \text{Weight of sample taken}} \times 100 \quad \ldots(1)$$

$$\text{Protein content} = \%N_2 \times 6.25 \quad \ldots.(2)$$

*Water activity* (*Aw*) :

Rotronic HW-3 and hydrolab3 unit was used for

measuring water activity of dehydrated chicken meat samples after drying and at 15 days interval for fourth months during storage stability study. Chicken meat powder was placed upto brim of water activity cup made of plastic. The cup was placed in sensor block and then probe was kept on it. Reading was noted from display penal.

*Thiobarbituric acid* (*TBA*) *value* :

Thiobarbituric acid number was analyzed as per procedure given by Tarladgis *et al.* (1960).Ten gram of dried chicken meat sample was taken and added to 49 ml distilled water and 1 ml of sulphanilamide reagent (1 g of sulphanilamide dissolved in solution containing 40 ml of conc. HCl and 60 ml of distilled water) and blended with the help of pestle and mortar. After this 48 ml of distilled water was used for washing the mortar and to it 2 ml HCl solution (1:2 with water) was added. The contents were transferred to Keldhal flask after adding several glass beads. These were heated on high heat and 50 ml distillate was collected into a graduated cylinder. After mixing the distillate well, a 5 ml portion was taken into a 50 ml glass stoppered flask and 5 ml of TBA reagent (1.442 g of TBA dissolved in 450 ml of glacial acetic acid and made upto 500 ml with distilled water) was added. The contents were mixed and the flask was immersed in boiling water bath for precisely 35 minutes. A blank was withal prepared consisting of 5 ml of distilled water and 5 ml of TBA reagent. The flask were then cooled under tap water for 10 minutes and the optical density (OD) was recorded at 538 nm against blank TBA water sample. The TBA value as mg of malonaldehyde per 1000 g of sample was calculated using following formula:

$$\text{TBA value}\left(\frac{\text{mg of malonaldehyde}}{\text{1000 g of sample}}\right) = \text{O. D. of sample x 7.8. (3.16)}$$

**Statistical analysis :**

The experiments were performed by three replications and three factors analysis of variance (CRD) was used for statistical analysis to examine the effect of packaging methods, treatments and storage time on water activity, TBA value and protein content of dehydrated chicken meat during 150 days of storage.

## EXPERIMENTAL FINDINGS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

**Effects on protein content of dehydrated chicken meat during storage :**

Fig.1 showed that throughout storage study of dehydrated chicken meat samples, it was found that protein content decreased with increasing in storage period for vacuum packaged chicken meat samples and conventional packaged treated chicken meat samples of both type samples (Morzel *et al.,* 2006). It can be seen that for conventional packaged treated chicken meat had 87.62 per cent and 85.23 per cent of protein contents for raw chicken meat and raw chicken meat samples, respectively on $0^{th}$ day of storage but in case of vacuum packed dehydrated chicken meat samples, it were 87.66 per cent and 85.34 per cent for treated raw chicken meat and raw chicken meat sample, respectively at $0^{th}$ day of storage. Which decreased upto 70.03 per cent and 68.34 per cent in conventional packaged treated meat and conventional packaged raw meat sample at 150 day, however, decreased in protein value was less for conventional packaged treated meat sample throughout the storage of 150 days. In case of vacuum packaged meat samples, it was found that for treated sample, the reduction of protein was less as compared to raw chicken meat sample during storage period. It was concluded that the protein value of raw meat was decreased in small amount for vacuum packaged sample as compared to conventional packaged raw meat sample throughout observation period whereas, for vacuum packaged treated meat samples, it was also found that it decreased with large amount as compared to conventional packaged raw meat sample during storage period. It was observed that protein was decreased significantly with prolonged storage. The similar research was reported by Sarma *et al.* (2000) they observed that protein of dry salted pink perch and Sardine meat was decreased significantly during storage.

Effect of vacuum packaging on protein value was observed. This result showed that protein content for both raw and treated was decreased more in case of conventional packaged meat samples as compared to vacuum packaged meat samples during storage period. It was observed that effect of packaging methods on protein content was significant ($p<0.05$) (Kim *et al.*, 2010). Maximum protein content was found in vacuum

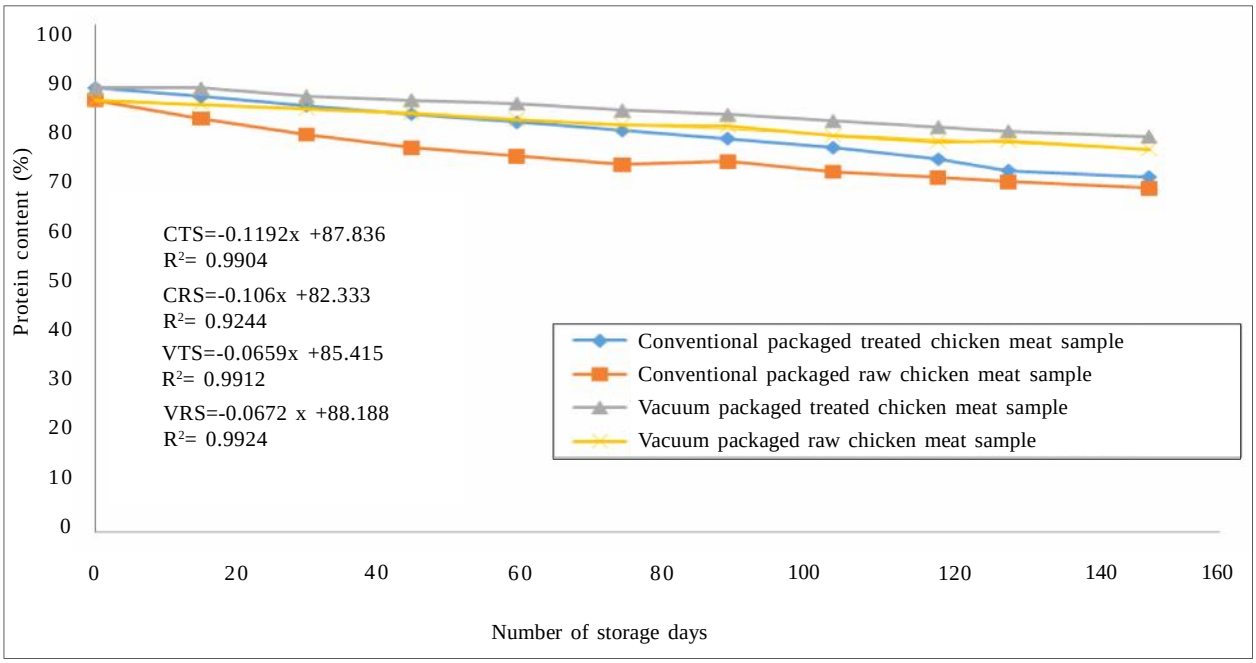


**Fig. 1 : Effects on protein content of vacuum packaged and conventional packaged dehydrated chicken meat samples during storage period of 150 days at ambient temperature**

packed chicken meat samples at 0th day of storage it decreased upto 77.55 per cent and minimum protein content was found as 76.79 per cent in conventional packaged chicken meat samples at 150 day of storage. Mean value of protein content was 78.80 per cent in vacuum packed meat sample and 79.85 per cent in conventional packaged chicken meat sample. It was found that effect of vacuum packaging on protein content was highly significant ($p<0.05$) followed by conventional packaging.

It was also observed that effect of conventional packaging on protein content was significant ($p<0.05$). It is concluded that protein content was more significantly decreased in conventional packaged chicken meat samples as compared to vacuum packed chicken meat sample. Effect of storage period on protein content was found significant ($p<0.05$) for vacuum packed meat sample and conventional packaged chicken meat sample. Maximum mean value of protein content was found in 0th day and minimum mean value was 77.17 per cent in 150 day of storage. However, the effect of interaction between storage period and packaging methods on protein content was observed significant ($p<0.05$). It was also found that effect of pre-treatment was found significant ($p<0.05$) in both samples (raw and treated). Highest mean value of protein was found 80.56 per cent in raw chicken meat sample and lowest was 78.09 per cent in treated chicken meat sample. It can be seen that treated sample was highly significant ($p<0.05$) followed by raw chicken meat sample. However, effect of storage on protein content was found significant in pre-treatment ($p<0.05$). There for effect of storage for pre-treatment was significant different. The results also showed that interaction between storage period and pre-treatment was observed significant ($p<0.05$).

It was also observed that value of $R^2$ was found 0.9904 for conventional packaged treated chicken meat sample and co-efficient of determination was found 0.9912 for vacuum packaged raw chicken meat sample. It was concluded that based on highest co-efficient of determination value, vacuum packaged treated chicken meat sample storied at 160 days was best among all storied chicken meat samples. Protein content data were best fitted in polynomial equations as co-efficient of determination ($R^2$) was found to be more than 0.99.

**Effects on water activity of dehydrated chicken meat during storage :**

Fig. 2 shows changes in water activity with prolong storage periods. As can be seen from this figure that

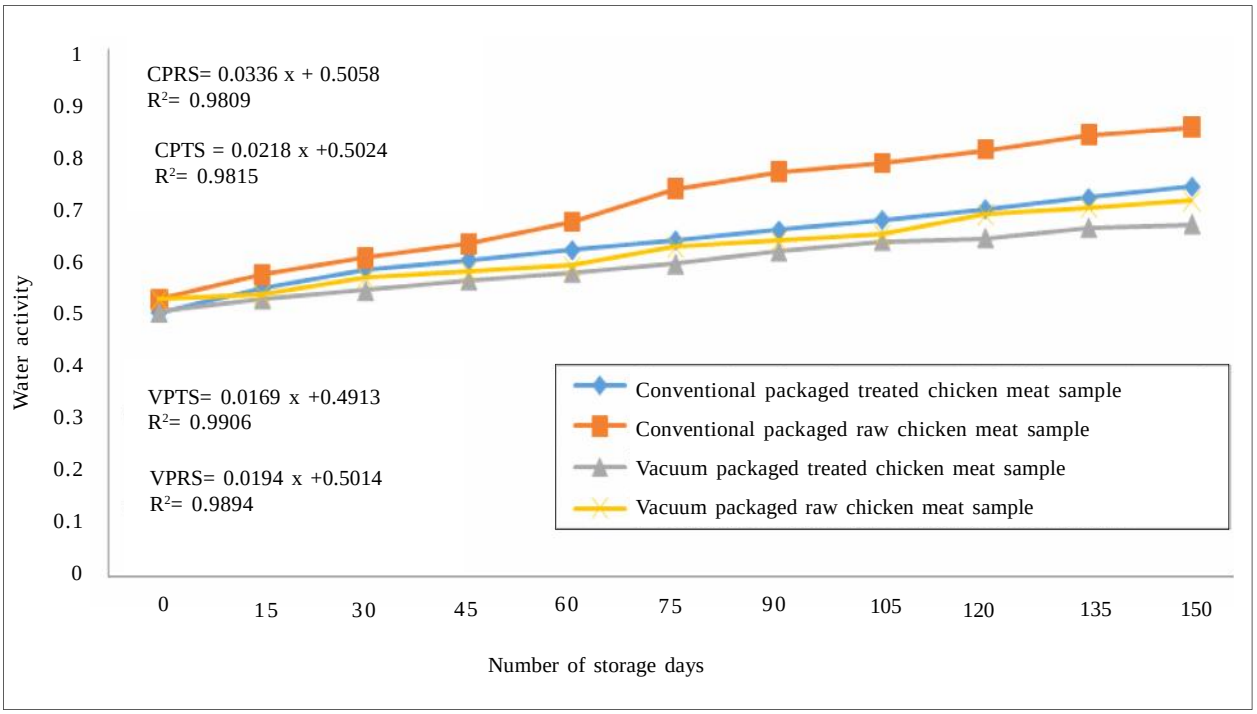


**Fig. 2 : Effects on water activity of vacuum packaged and conventional packaged dehydrated chicken meat samples during storage of 150 days at ambient temperature**

water activity increased with prolonged storage in all types of chicken meat sample. Effect of storage period, packaging methods and treatments on water activity of dehydrated chicken meat was found significant ($p<0.05$), whereas, interaction between storage and packaging, interaction between packaging and pre-treatment, interaction between storage and pre-treatment and interaction among storage, packaging and pre-treatment on water activity also was found to be significant ($p<0.05$). Similar findings have been reported by Morales *et al.* (2009). From analysis of variance, it was found that for raw meat, mean value of water activity was found 0.513 at 0$^{th}$ day and 0.803 at 150$^{th}$day while for treated meat, mean value of water activity was found to be 0.513 at 0$^{th}$ day and 0.697 at 150$^{th}$ day. Overall mean value for water activity was found to be 0.606 for treated meat and 0.675 for raw chicken meat. It was found that mean overall mean value for treated meat was higher than raw meat.

Sodium nitrite had pronounced effect of water activity during storage period. It was observed that mean value of water activity increased with storage period (Lee *et al.,* 2016). From the 0$^{th}$ day to 150$^{th}$ day, water activity varied from 0.501 to 0.710 and it also varied from 0.525 to 0.79 in conventional packaging of chicken meats. Overall mean value of water activity was found 0.615 vacuum packaging of chicken meats and 0.667 in conventional packaging in of chicken meat. It was cleared that effect of vacuum packaging on water activity was observed highly significant ($p<0.05$) as compared to conventional packaging of chicken meat. From regression analysis co-efficient of determination ($R^2$) was found 0.9906 for vacuum packaging of treated chicken meat and 0.9894 for vacuum packaging of raw chicken meat whereas it was found to be 0.9809 for conventional packaged treated chicken meat and 0.9815 for conventional packaged raw chicken meat. It was found that water activity data were best fitted in regression equations as co-efficient of determination ($R^2$) was higher than 0.98.

**Effects on TBA number of dehydrated chicken meat during storage :**

As shown in Fig. 3, the TBA number value of dehydrated chicken meat of treated and raw samples for both conventional and vacuum packaging, was increased with increasing in storage period. Mean values of TBA number were found to be 0.0309, 0.345, 0.3885 and

0.741mg malonaldehyde/kg in vacuum packed chicken meat and 0.309, 0.334, 0.362 and 0.665mg malonaldehyde/kg in conventional packaged chicken meat at 0th,15th, 30th and 150 day of storage, respectively. It was also observed that mean value of TBA number was found to be 0.485mg malonaldehyde/kg for vacuum packaged meat and 0.531mg malonaldehyde/kg for conventional packaged meat. Thus, effect of vacuum packaging on TBA number value of dehydrated chicken was found to be highly significant ($p<0.05$) as compared to conventional packaging (Fernandes *et al.*, 2014). Dehydrated chicken meat packaged in vacuum pouches indicated low TBA value because of delay of oxidation of unsaturated fatty acid which present in chicken meat product. The presence of oxygen within the pouches was effect substance for lipid oxidation. Similar observations of Nam *et al.* (2002) were reported. In their research where they found that vacuum packaging was extra effective means to delay oxidation of lipid in many meat products. Effect of factor storage, factor pre-treatment and factor packaging was found to be significant ($p<0.05$). But factor storage showed highly significant difference followed by factor pre-treatment and factor packaging. At 0th day of storage, the mean value of TBA number was found to be 0.295 mg malonaldehyde/kg for treated meat and 0.323 mg malonaldehyde/kg for raw meat while at 150th day of storage, the mean value of TBA number was found 0.652 mg malonaldehyde/kg for treated meat and 0.740 mg malonaldehyde/kg for raw meat. However, overall mean value of TBA number was found to be 0.475 mg malonaldehyde/kg for treated meat and 0.540 mg malonaldehyde/kg for raw meat. It was cleared that the effect of sodium nitrite treatment on TBA number was observed highly significant ($p<0.05$) than raw chicken meat sample.In our experiment, TBA value was increased significantly with prolonged storage (Dong and Keun, 2012).

## Conclusion :

TBA values significantly increased with advancement of storage period in all cases. It was found to be maximum for raw sample as compared to treated sample during storage period. Water activity increased significantly with prolong storage period in vacuum packaged as well as conventional packaged sample however, for conventional packaged it was found to be higher than vacuum packaged sample. Water activity also increased significantly with increasing in storage period

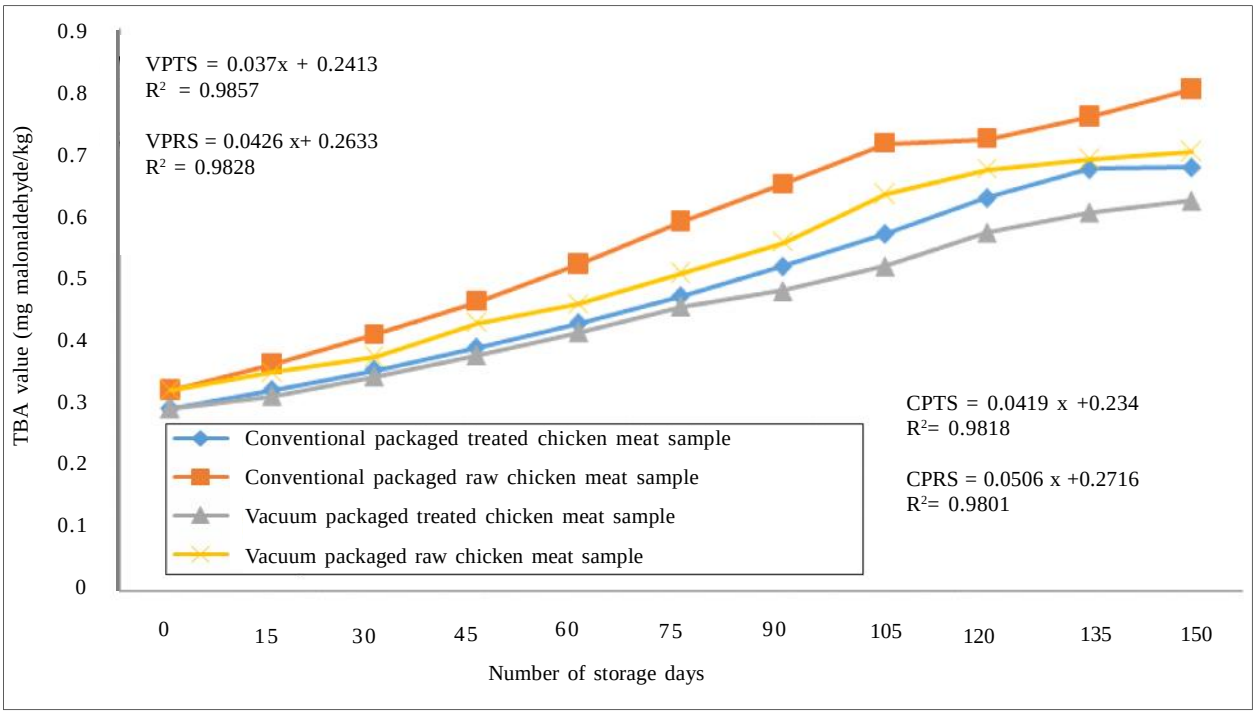


**Fig. 3 : Effects on TBA value (mg malonaldehyde/kg) of vacuum packaged and conventional packaged dehydrated chicken meat samples during storage of 150 days at ambient temperature**

both in treated as well as raw sample. Protein content of dehydrated product decreased both in vacuum packaged as well as conventional packaged sample but protein content for vacuum packaged was higher than conventional packaged sample during the storage period and differences were significant. The protein content increased with advancement of storage period both in raw and treated sample. The protein content was significantly higher for sodium nitrite treated sample throughout storage. Effect of storage time was found to significant in all cases. Chicken meat could unspoiled for more than 150 days and quality was acceptable.

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