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Effect of different storage and packaging conditions on physico-chemical quality of frozen broiler chicken

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Abstract

Freezing is the process of extending the shelf life of broiler chicken meat. Since frozen meat is getting popular among the consumers, a study was undertaken to estimate the physicochemical quality of frozen broiler chicken meat samples stored at -12 °C, -18 °C, -24 °C under aerobic and vacuum packaging for one year. The overall mean value of aerobic and vacuum-packed frozen chicken meat samples stored under three different storage (-12 °C, -18 °C and -24 °C) conditions decreased significantly ($P < 0.01$) to 5.61 ± 0.03 as compared to day zero. The overall temperature (-12 °C, -18 °C and -24 °C) storage mean pH values are 5.66 ± 0.01 for -12 °C, 5.63 ± 0.01 for -18 °C and 5.60 ± 0.01 for -24 °C and showed a significant difference ($P < 0.01$) among the frozen broiler meat samples. The overall temperature (-12 °C, -18 °C and -24 °C) storage mean pH values are 5.66 ± 0.01 for -12 °C, 5.63 ± 0.01 for -18 °C and 5.60 ± 0.01 for -24 °C and showed a significant difference ($P < 0.01$) among the frozen broiler meat samples.

Keywords: broiler chicken meat, freezing, storage studies, physicochemical properties

Introduction

Currently, the consumption of broiler chicken is more prevalent in the different sections of people in the world because of advantages such as higher protein, easy digestibility and lower cost as compared to other meat of various food animals. Broiler chicken can be preserved for longer-term storage through canning, drying, or freezing. Now a days, utilization of frozen chicken is ever increasing over the years and is being marketed by many processing plants commercially. Freezing is one of the best preservation methods for broiler meat as compared with other methods, and it leads to a minimal loss of quality during long-term storage. Frozen storage is used to hurdle undesirable biochemical reactions like lipid oxidation and sensory changes in frozen meat. Still, some cell disruption and destruction of muscle fibre due to the formation of ice crystals. The knowledge of practical storage life of chicken under frozen conditions is of commercial importance to the stakeholders and consumers. There seems to be a limited study on frozen broiler chicken meat's practical storage life under Indian conditions was carried out. To fulfil the gap, this study was carried out to estimate the pH in the samples stored under aerobic and vacuum packed frozen broiler chicken meat at different temperature conditions. Exploring these physicochemical attributes under different storage conditions will pave the way for long-term preservation of whole broiler chicken meat for utilization by the consumers and recommend a suitable method of preservation commercially.

Materials and Methods

A total of 270 number blast frozen whole broiler chicken carcasses, divided into 3 groups each having 90 broiler chicken carcass each (45 aerobic and 45 vacuum packaged), were purchased from the commercial processing plant at Udumalaipet, Tirupur district, Tamil Nadu, India, with ten days interval for each group. Six freshly slaughtered and chilled broiler chicken carcasses each were also procured from the same unit along with the regular package and kept as control. The purchased whole chicken carcasses (270 numbers) were transported to the Department of Livestock products Technology (Meat Science), Veterinary College and Research Institute, Namakkal, Tamil Nadu, India and kept in the dedicated deep freezer, maintaining the sub-zero temperature of -12 °C, -18 °C and -24 °C for 12 months. Broiler chicken carcass samples stored under different temperature will be drawn out one day before

the experiment and it was thawed overnight in the chiller maintained at 4 °C and the broiler breast muscles (*Musculus pectoralis*) were separated from the thawed carcass and utilized for the study of microbiological analysis such as psychrophilic count, Streptococcal count and yeast and mould count at an interval of 30 days for 12 months for each group and all the samples were analysed in duplicate for each parameter.

The assessment of pH of the breast sample was made using a digital pH meter (Model 361, Systronics, India). About 5 g of meat was homogenised with 45 ml of distilled water in a laboratory blender for about one minute. The pH was recorded by immersing the combined glass electrode of digital pH meter in the homogenate.

The data generated from the study were pooled and statistically analyzed (Snedecor and Cochran, 1989)

Results and Discussion

The result of pH values (Mean \pm SE) of aerobic and vacuum-packed frozen broiler chicken meat samples stored under three different storage (-12 °C, -18 °C and -24 °C) conditions are presented in Table 1.

On day 0, the mean \pm pH value of fresh chicken meat sample before packaging and storage study was 5.82 \pm 0.04. At the end of the first month of storage, the overall mean value of aerobic and vacuum-packed frozen chicken meat samples stored under three different storage (-12 °C, -18 °C and -24 °C) conditions decreased significantly ($P < 0.01$) to 5.61 \pm 0.03 as compared to day zero. However, the overall mean pH values were comparable between frozen storage months and showed no significant difference among them.

The overall packaging means pH value for the aerobically stored frozen broiler chicken meat at -12 °C, -18 °C and -24 °C temperature is 5.63 \pm 0.01 and vacuum stored is 5.64 \pm 0.01, respectively. From table 1, either aerobic or vacuum packaging types under three different storage (-12 °C, -18 °C and -24 °C) conditions, the pH values indicates. that has no effect on the pH values of the broiler chicken meat samples.

Instead, the overall temperature (-12 °C, -18 °C and -24 °C) storage mean pH values are 5.66 \pm 0.01 for -12 °C, 5.63 \pm 0.01 for -18 °C and 5.60 \pm 0.01 for -24 °C and showed a significant difference ($P < 0.01$) among the frozen broiler meat samples.

The overall temperature (-12 °C, -18 °C and -24 °C) storage

mean pH values are 5.66 \pm 0.01 for -12 °C, 5.63 \pm 0.01 for -18 °C and 5.60 \pm 0.01 for -24 °C and showed a significant difference ($P < 0.01$) among the frozen broiler meat samples.

On day 0, all the fresh chicken meat samples had a similar pH value (5.82) and there is no significant difference between the treatment samples and the pH values are in accordance with [1] who reported a initial pH value of 5.87 for fresh chicken meat [2] reported a pH value of 5.86 for skinless boneless pale meat and 6.68 for normal chicken breast meat.

The frozen broiler chicken meat samples packed under aerobic or vacuum conditions and stored under -12 °C, -18 °C and -24 °C temperature from the first month the to the end of twelfth month; the pH values noticed very lesser changes, but these changes are not statistically significant. The pH values showed a decreasing trend either with aerobic or vacuum-packed samples with storage at -12 °C, -18 °C and -24 °C with the mean pH value of 5.64, 5.68 5.55 and 5.73, 5.69, 5.61 respectively. Frozen meat stored in freezing conditions (temperature -20 ± 1 °C and 40% humidity) for 1, 3, 5, and 7 months and the water thawed samples had a pH of 5.96, 5.96, 5.86 and 5.99 respectively and simultaneously the microwave thawed meat has 5.91, 5.90, 5.86 and 5.89 respectively [4]. The pH of frozen broiler breast meat individually packed into moisture impermeable polyethylene bags and then stored -18 °C for up to 8 months and reported that the pH of the fresh chicken meat was 6.09, and from first month to eight months of storage, the pH values were 5.96, 5.97, 5.99, 5.99, 5.97, 5.95, 5.94, and 5.99 respectively [5]. The freezing with subsequent exudate release and the loss of water from the meat may cause an increase in the concentration of the solutes, resulting in a decrease in the pH of thawed meat [1].

In the present investigation, the pH values were dropped significantly in both aerobic and vacuum packaging and the temperature of storage (-12 °C, -18 °C and -24 °C) has a significant influence in the pH values of the frozen broiler meat samples. The results of the pH value of fresh broiler chicken meat samples are in accordance with those of [2, 3]. Further, the frozen broiler chicken meat samples, the obtained pH values are nearer to the pH value of [4, 5]. More specifically, the decrease in the pH value up to 12 month storage period could be correlated with the report of [1].

Table 1: pH of aerobic and vacuum packaged frozen broiler chicken under different storage temperature for different storage period.

Storage Period	Aerobic Packaging			Vacuum Packaging			Overall storage period mean
	-12 °C	-18 °C	-24 °C	-12 °C	-18 °C	-24 °C	
0 Day	5.82 \pm 0.04	5.82 \pm 0.04	5.82 \pm 0.04	5.82 \pm 0.04	5.82 \pm 0.04	5.82 \pm 0.04	5.82 \pm 0.02 ^A
1 Month	5.59 \pm 0.07	5.61 \pm 0.03	5.49 \pm 0.04	5.68 \pm 0.05	5.51 \pm 0.07	5.77 \pm 0.06	5.61 \pm 0.03 ^B
2 Month	5.58 \pm 0.06	5.60 \pm 0.03	5.61 \pm 0.06	5.76 \pm 0.06	5.53 \pm 0.09	5.67 \pm 0.03	5.62 \pm 0.03 ^B
3 Month	5.67 \pm 0.06	5.62 \pm 0.08	5.59 \pm 0.09	5.66 \pm 0.04	5.59 \pm 0.07	5.60 \pm 0.06	5.62 \pm 0.03 ^B
4 Month	5.62 \pm 0.06	5.68 \pm 0.06	5.51 \pm 0.08	5.71 \pm 0.09	5.60 \pm 0.06	5.58 \pm 0.07	5.62 \pm 0.03 ^B
5 Month	5.66 \pm 0.07	5.60 \pm 0.08	5.48 \pm 0.08	5.54 \pm 0.03	5.65 \pm 0.05	5.48 \pm 0.09	5.57 \pm 0.03 ^B
6 Month	5.63 \pm 0.07	5.66 \pm 0.07	5.56 \pm 0.03	5.57 \pm 0.05	5.64 \pm 0.09	5.52 \pm 0.13	5.60 \pm 0.03 ^B
7 Month	5.60 \pm 0.10	5.43 \pm 0.10	5.59 \pm 0.11	5.65 \pm 0.04	5.57 \pm 0.07	5.69 \pm 0.03	5.59 \pm 0.03 ^B
8 Month	5.64 \pm 0.06	5.72 \pm 0.06	5.66 \pm 0.04	5.67 \pm 0.10	5.56 \pm 0.03	5.66 \pm 0.02	5.65 \pm 0.02 ^B
9 Month	5.63 \pm 0.05	5.67 \pm 0.05	5.55 \pm 0.05	5.63 \pm 0.06	5.52 \pm 0.06	5.66 \pm 0.02	5.61 \pm 0.02 ^B
10 Month	5.67 \pm 0.09	5.66 \pm 0.08	5.49 \pm 0.05	5.68 \pm 0.06	5.64 \pm 0.02	5.66 \pm 0.04	5.63 \pm 0.03 ^B
11 Month	5.74 \pm 0.08	5.67 \pm 0.05	5.59 \pm 0.08	5.61 \pm 0.06	5.71 \pm 0.08	5.53 \pm 0.07	5.64 \pm 0.03 ^B
12 Month	5.64 \pm 0.09	5.68 \pm 0.06	5.55 \pm 0.11	5.73 \pm 0.08	5.69 \pm 0.08	5.61 \pm 0.03	5.65 \pm 0.03 ^B
Overall packaging mean	5.63 \pm 0.01			5.64 \pm 0.01			
Overall temperature mean	-12 °C			5.66 \pm 0.01 ^Y			
	-18 °C			5.63 \pm 0.01 ^{XY}			
	-24 °C			5.60 \pm 0.01 ^X			

Means bearing different superscripts differ significantly.

Conclusion

From the above study on the physicochemical qualities of pH, the frozen broiler chicken meat samples packed under aerobic or vacuum condition and stored under -12 °C, -18 °C and -24 °C temperature from the first month to at the end of twelfth month, the pH values noticed very lesser changes but these changes are not statistically significant. had a significant decrease in the total count over a storage period of one year. the pH values were dropped significantly in both aerobic and vacuum packaging and the temperature of storage (-12 °C, -18 °C and -24 °C) has a significant influence in the pH values of the frozen broiler meat samples. So from this study, it can be concluded as the storage period increases the pH value dropped significantly.

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