



International Journal of Veterinary Sciences and Animal Husbandry



ISSN: 2456-2912

NAAS Rating (2026): 4.61

VET 2026; 11(5): 251-256

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www.veterinarypaper.com

Received: 16-02-2026

Accepted: 19-03-2026

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Storage stability and shelf life of chicken cutlets under chilling and super chilling temperatures

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DOI: <https://www.doi.org/10.22271/veterinary.2026.v11.i5d.3275>

Abstract

A study was conducted to evaluate the effect of chilling and super chilling storage temperatures on the physico-chemical, microbial and sensory quality characteristics of chicken cutlets. Chicken cutlets were prepared using standardized formulation, aerobically packed in low density polyethylene pouches and stored under chilling ($4 \pm 1^\circ\text{C}$) and super chilling (-1 to -2°C) temperatures. Samples were evaluated periodically during storage for physico-chemical, microbial and sensory quality parameters. Significant ($P < 0.01$) increase in pH, oil uptake, free fatty acid (FFA), tyrosine and thiobarbituric acid (TBA) values was observed during storage under both storage conditions, whereas moisture and moisture retention values decreased significantly ($P < 0.01$). Total plate count, psychrophilic count and yeast and mould count increased significantly ($P < 0.01$) during storage under both storage conditions. However, microbial proliferation and oxidative changes were comparatively lower in super chilled samples than chilled samples. Coliform organisms were not detected throughout the storage period under either storage condition. Sensory scores for appearance and colour, flavour, juiciness, tenderness and overall acceptability decreased significantly ($P < 0.01$) during storage. Chilled samples developed spoilage characteristics after 10 days of storage, whereas super chilled samples retained acceptable quality up to 15 days of storage. The results indicated that super chilling storage was more effective in retarding microbial growth, physico-chemical deterioration and sensory quality loss, thereby extending the shelf life of chicken cutlets compared to conventional chilling storage.

Keywords: Chicken cutlets, chilling storage, super chilling storage, physico-chemical quality, microbial stability, shelf life

1. Introduction

Chicken meat is widely preferred owing to its high-quality protein content, desirable flavour and comparatively low fat content. Rapid urbanization and changing consumer lifestyles have further increased the demand for convenient ready-to-eat and ready-to-cook meat products (Barden and Decker, 2016) [3]. Among these products, chicken cutlets have gained considerable popularity due to their desirable texture, palatability and wide consumer acceptance (Anna Anandh, 2019) [1].

The storage stability of processed meat products is largely influenced by hygienic processing practices and storage temperature. Conventional chilling storage ($4 \pm 1^\circ\text{C}$) is commonly employed for short-term preservation to suppress microbial growth and retard biochemical deterioration. However, psychrophilic spoilage microorganisms are capable of proliferating even under refrigerated conditions, thereby limiting the shelf life of such products (Rathod *et al.*, 2022) [11]. To overcome these limitations, super chilling has emerged as an effective preservation technique. Super chilling involves storing products at temperatures slightly below their initial freezing point (-1 to -2°C), which markedly retards microbial growth and enzymatic activity. Unlike complete freezing, super chilling minimizes extensive ice crystal formation, thereby helping to preserve the structural integrity and sensory quality of meat products (Choe *et al.*, 2016) [4].

During storage, meat products undergo several physico-chemical, microbial and sensory changes that influence product quality and consumer acceptability (Liu *et al.* 2012) [9]. Lipid oxidation, moisture loss and microbial activity are the major factors responsible for quality

deterioration during storage. Therefore, the present study was undertaken to evaluate and compare the physico-chemical, microbial and sensory quality characteristics of chicken cutlets stored under conventional chilling and super chilling conditions.

Materials and Methods

Raw material preparation

Fresh boneless chicken meat was procured from a local poultry processing facility. Visible fat and connective tissues were trimmed manually and the meat was cut into small chunks. The meat chunks were partially frozen for 1hr to facilitate mincing and subsequently minced twice using a commercial meat mincer fitted with a 5 mm diameter die plate.

Formulation and preparation of chicken cutlets

The standardized formulation for chicken cutlets was prepared on a meat-weight basis as follows: minced chicken meat (100%), cooked mashed potato (100%), breadcrumbs (10%), refined vegetable oil (8%), condiment paste (5%), whole egg (5%), spice mix (3%) and salt (2%). The condiment paste consisted of onion, garlic and ginger in a 3:2:1 ratio.

The minced meat was thoroughly mixed with mashed potato, breadcrumbs, condiments, spices, salt and other ingredients until a uniform batter was obtained. Portions of approximately 50 g were shaped into oval cutlets using moulds. The cutlets were dipped in beaten egg and coated uniformly with breadcrumbs. The prepared cutlets were deep-fat fried in refined vegetable oil until a uniform golden-brown colour and safe internal cooking temperature were achieved. After frying, the cutlets were cooled to room temperature ($25 \pm 2^\circ\text{C}$), aerobically packaged in low-density polyethylene (LDPE) pouches, and divided into two storage treatments: conventional chilling ($4 \pm 1^\circ\text{C}$) and super chilling (-1 to -2°C).

Physico-chemical analysis

The pH of the samples was determined using a calibrated digital pH meter after homogenization with distilled water. Moisture content was estimated by drying the samples in a hot-air oven until constant weight was attained. Moisture retention and oil uptake values were calculated using standard gravimetric procedures.

Free fatty acid (FFA) content was determined by lipid extraction followed by titration and expressed as percentage oleic acid (Koniacko, 1979) [8]. Tyrosine value of stored samples was determined based on the procedure of Strange *et al.* (1977) [13]. Thiobarbituric acid (TBA) values were estimated spectrophotometrically using the distillation method and expressed as mg malonaldehyde / kg product (Witte *et al.* 1970) [16].

Microbial analysis

Total plate count, psychrophilic count, coliforms and yeast and mould counts were determined according to APHA (1984) [2]. Ready-made media (Hi-Media Laboratories Pvt. Ltd., Mumbai, India) were used. Serial dilutions were prepared using sterile peptone water and appropriate culture media were used for enumeration of total plate count (TPC), psychrophilic count, coliform count and yeast and mould count. Samples from both storage treatments were analyzed at regular intervals during storage (days 0, 5, 10, and 15). Microbial counts were expressed as $\log_{10}$ cfu/gm.

Sensory evaluation

Sensory evaluation was conducted by a panel of semi-trained judges using a 9-point hedonic scale, where a score of 9 indicated “extremely desirable” and a score of 1 indicated “extremely undesirable.” The sensory parameters evaluated included appearance and colour, flavour, juiciness, tenderness and overall acceptability (Keeton, 1983) [7].

Statistical analysis

The experiment was replicated six times ($n = 6$). Data obtained from the study were subjected to analysis of variance (ANOVA) and mean comparison tests following the procedures described by Snedecor and Cochran (1989) [12]. Differences among means were considered significant at $P < 0.01$.

Results and Discussion

Changes in physico-chemical characteristics

The changes in physico-chemical characteristics of chicken cutlets stored under chilling ($4 \pm 1^\circ\text{C}$) and super chilling (-1 to -2°C) temperatures are presented in Table 1. Significant ($P < 0.01$) increase in pH values was observed during storage under both storage conditions. In chilled samples, pH values increased from 6.18 ± 0.02 on day 0 to 6.46 ± 0.04 on day 10. Further analysis was not performed on day 15 due to spoilage of the samples. In super chilled samples, pH values increased gradually from 6.18 ± 0.02 to 6.38 ± 0.03 on day 15. The increase in pH during storage might be due to degradation of proteins and formation of basic compounds by microbial activity (Webster *et al.*, 1982) [15]. The comparatively lower pH values observed in super chilled samples indicated slower microbial and biochemical changes under lower storage temperatures (Jyothikartika *et al.*, 2025) [6].

Moisture content decreased significantly ($P < 0.01$) during storage under both storage conditions. Moisture values decreased from 64.24 ± 0.72 to 58.16 ± 0.75 per cent in chilled samples on day 10, whereas in super chilled samples moisture values decreased from 64.24 ± 0.70 to 58.28 ± 0.71 per cent on day 15. The reduction in moisture content might be due to evaporation and drip loss occurring during storage. Super chilled samples retained comparatively higher moisture content indicating better water holding capacity under lower storage temperatures (Jeeva *et al.*, 2025) [5].

Moisture retention values decreased significantly ($P < 0.01$) during storage under both storage conditions. In chilled samples, moisture retention values decreased progressively from 60.42 ± 0.68 per cent on day 0 to 54.06 ± 0.70 per cent on day 10. Further analysis was not performed on day 15 due to spoilage of the samples. In super chilled samples, moisture retention values decreased gradually from 60.42 ± 0.68 to 55.84 ± 0.74 per cent on day 15. The reduction in moisture retention during storage might be attributed to moisture loss, protein denaturation and reduction in water holding capacity of meat proteins during storage (Xia *et al.* (2019) [17]. The comparatively higher moisture retention values observed in super chilled samples indicated better retention of water within the product matrix under lower storage temperatures (Jyothikarthikka *et al.*, 2025) [6].

Oil uptake values increased significantly ($P < 0.01$) during storage under both storage conditions. In chilled samples, oil uptake values increased from 8.86 ± 0.02 per cent on day 0 to 9.62 ± 0.03 per cent on day 10. In super chilled samples, oil uptake values increased gradually from 8.86 ± 0.03 to 9.22 ± 0.05 per cent on day 15. The increase in oil uptake during storage might be due to reduction in moisture content and

structural changes occurring in the product during storage, which facilitated absorption of oil. The comparatively lower oil uptake values observed in super chilled samples might be due to better moisture retention and reduced structural deterioration under super chilling conditions.

FFA values increased significantly ($P < 0.01$) during storage under both storage conditions. In chilled samples, FFA values increased from 0.26 ± 0.01 to 0.74 ± 0.02 per cent oleic acid on day 10. In super chilled samples, FFA values increased gradually from 0.26 ± 0.01 to 0.52 ± 0.02 per cent oleic acid on day 15. The increase in FFA values indicated progressive hydrolysis of lipids during storage. The comparatively lower FFA values observed in super chilled samples suggested better oxidative stability under super chilling conditions. These findings agree with Jyothikarthikka *et al.* (2025) [6], who reported increase in FFA values under lower storage temperatures.

Tyrosine values increased significantly ($P < 0.01$) during storage under both storage conditions. In chilled samples, tyrosine values increased from 8.42 ± 0.22 to 17.62 ± 0.30 mg tyrosine/100 gm on day 10, whereas in super chilled samples the values increased from 8.42 ± 0.22 to 17.42 ± 0.30 mg tyrosine/100 gm on day 15. The increase in tyrosine values during storage might be due to proteolytic degradation of proteins by microbial and enzymatic activity. The comparatively slower increase in tyrosine values observed in super chilled samples indicated reduced proteolysis under lower storage temperature. These findings agree with Jeeva *et al.* (2025) [5], who reported increase in tyrosine values under chilling and super chilling temperatures.

TBA values increased significantly ($P < 0.01$) during storage under both storage conditions. In chilled samples, TBA values increased from 0.18 ± 0.01 to 0.82 ± 0.03 mg malonaldehyde / kg on day 10. In super chilled samples, TBA values increased gradually from 0.18 ± 0.01 to 0.52 ± 0.02 mg malonaldehyde / kg on day 15. The increase in TBA values indicated progressive lipid oxidation during storage. However, the comparatively lower TBA values observed in super chilled samples indicated better oxidative stability under super chilling conditions. TBA values across all treatments remained below the threshold limit of 1–2 mg/kg (Pearson, 1967) [10]. Our present results are in agreement with previous reports of Jeeva *et al.* (2025) [5] and Jyothikarthikka *et al.* (2025) [6]. They reported that super chilling storage delays lipid oxidation.

Overall, the physico-chemical changes observed during storage were more pronounced under chilling storage than super chilling storage, indicating the effectiveness of super chilling temperature in retarding biochemical deterioration and maintaining quality characteristics of chicken cutlets during storage.

Changes in microbial quality

The changes in microbial quality of chicken cutlets stored under chilling (4 ± 1 °C) and super chilling (-1 to -2 °C) temperatures are presented in Table 2. A significant ($P < 0.01$) increase in total plate count was observed during storage under both storage conditions. In chilled samples, total plate count increased from 2.22 ± 0.07 log₁₀ cfu / gm on day 0 to 4.68 ± 0.08 log₁₀ cfu / gm on day 10. Further analysis was not performed on day 15 due to spoilage of the product under chilling storage. In super chilled samples, total plate count increased gradually from 2.22 ± 0.07 to 4.42 ± 0.08 log₁₀ cfu / gm on day 15. The comparatively lower total plate count observed in super chilled samples indicated that lower storage

temperature effectively retarded microbial proliferation and improved microbiological stability of chicken cutlets. Similar inhibitory effects of low temperature storage on microbial proliferation have been reported by Jeeva *et al.* (2025) [5] and Jyothikarthikka *et al.* (2025) [6].

Psychrophilic counts were not detected initially under both storage conditions. However, psychrophilic counts increased significantly ($P < 0.01$) during storage and reached 3.72 ± 0.08 log₁₀ cfu / gm in chilled samples on day 10. In super chilled samples, psychrophilic counts increased from 2.18 ± 0.05 log₁₀ cfu / gm on day 5 to 3.68 ± 0.07 log₁₀ cfu / gm on day 15. The slower increase in psychrophilic counts observed under super chilling conditions indicated inhibition of cold-tolerant spoilage microorganisms at lower storage temperatures. Our present results are in agreement with Jyothikarthikka *et al.* (2025) [6], who reported that super chilling storage reduced the metabolic activity of psychrophilic organisms and inhibit their growth.

Coliform counts were not detected throughout the storage period under both chilling and super chilling conditions. Absence of coliform organisms indicated satisfactory hygienic quality of raw materials and maintenance of proper sanitary conditions during processing and storage of chicken cutlets. Lakshmanan *et al.* also observed that hygienically processed poultry stored under subzero conditions remained free from coliform contamination.

Yeast and mould counts increased significantly ($P < 0.01$) during storage under both storage conditions. In chilled samples, yeast and mould counts increased from 2.72 ± 0.18 log₁₀ cfu/g on day 0 to 3.28 ± 0.15 log₁₀ cfu/g on day 10. In super chilled samples, the corresponding values increased from 2.72 ± 0.18 to 3.22 ± 0.13 log₁₀ cfu/gm on day 15. The comparatively lower yeast and mould counts observed in super chilled samples might be due to the inhibitory effect of lower storage temperatures on fungal growth (Jeeva *et al.*, 2025) [5].

Across treatments, microbial counts remained well below the spoilage limit of 6.7 log₁₀ cfu/gm (Von Holy and Holzapet, 1988) [14], with no visible spoilage symptoms. These results confirm that super chilling significantly suppresses microbial proliferation, extending microbial acceptability by 1 to 2 weeks compared to chilling.

Visible spoilage signs such as slime formation and development of off-odour were observed in chilled samples after 10 days of storage, whereas super chilled samples retained acceptable microbiological quality throughout 15 days of storage. Overall, the microbial results indicated that super chilling effectively retarded bacterial and fungal growth and thereby improved the shelf life and microbiological stability of chicken cutlets compared to conventional chilling storage.

Changes in sensory quality

The changes in sensory quality of chicken cutlets stored under chilling (4 ± 1 °C) and super chilling (-1 to -2 °C) temperatures are presented in Table 3. Sensory scores for appearance and colour, flavour, juiciness, tenderness and overall acceptability decreased significantly ($P < 0.01$) during storage under both storage conditions.

Appearance and colour scores decreased progressively during storage under both storage conditions. In chilled samples, appearance and colour scores decreased from 8.42 ± 0.06 on day 0 to 6.74 ± 0.10 on day 10. Further sensory evaluation was not performed on day 15 due to spoilage of the samples. In super chilled samples, appearance and colour scores

decreased gradually from 8.42 ± 0.06 to 7.12 ± 0.12 on day 15. The reduction in appearance and colour scores during storage might be due to pigment oxidation, moisture loss and surface dehydration occurring during storage. The comparatively higher appearance and colour scores observed in super chilled samples indicated better retention of visual quality under lower storage temperatures

Flavour scores decreased significantly ($P < 0.01$) during storage under both storage conditions. In chilled samples, flavour scores decreased from 8.36 ± 0.08 on day 0 to 6.42 ± 0.12 on day 10, whereas in super chilled samples the corresponding values decreased from 8.36 ± 0.08 to 6.94 ± 0.14 on day 15. The reduction in flavour scores might be associated with microbial spoilage and lipid oxidation occurring during storage. Super chilled samples retained comparatively higher flavour scores throughout storage period indicating slower development of off-flavours under super chilling conditions.

Juiciness scores also decreased significantly ($P < 0.01$) during storage under both storage conditions. Juiciness scores decreased from 8.28 ± 0.08 to 6.34 ± 0.12 in chilled samples and from 8.28 ± 0.08 to 6.82 ± 0.14 in super chilled samples. The decrease in juiciness scores might be due to moisture loss and reduced water holding capacity during storage. The comparatively higher juiciness scores observed in super chilled samples indicated better moisture retention under lower storage temperatures.

Tenderness scores decreased significantly ($P < 0.01$) during

storage under both storage conditions. In chilled samples, tenderness scores decreased from 8.34 ± 0.08 on day 0 to 6.58 ± 0.12 on day 10. In super chilled samples, tenderness scores decreased gradually from 8.34 ± 0.08 to 6.96 ± 0.14 on day 15. The reduction in tenderness scores during storage might be attributed to structural changes in muscle proteins and moisture loss occurring during storage.

Overall acceptability scores decreased significantly ($P < 0.01$) during storage under both storage conditions. In chilled samples, overall acceptability scores decreased from 8.40 ± 0.08 on day 0 to 6.52 ± 0.12 on day 10. In super chilled samples, overall acceptability scores decreased from 8.40 ± 0.08 to 7.02 ± 0.14 on day 15. The comparatively higher overall acceptability scores observed in super chilled samples indicated better maintenance of sensory quality during storage. Jeeva *et al.* (2025) ^[5] and Jyothikarthikka *et al.* (2025) ^[6] also reported that super chilling extends sensory attributes of samples of meat products as compared to super chilling temperature.

Visible spoilage signs such as slime formation and off-odour development were observed in chilled samples after 10 days of storage, resulting in discontinuation of sensory evaluation on day 15. However, super chilled samples retained acceptable sensory quality throughout 15 days of storage. Overall, the sensory results indicated that super chilling storage was more effective in preserving sensory quality and extending the shelf life of chicken cutlets compared to conventional chilling storage.

Table 1: Changes in physico-chemical parameters of chicken cutlets during storage under chilling (4 ± 1 °C) and super chilling (-1 to -2 °C) temperatures (Mean $\pm$ S.E)

Treatments	Period (days)				Treatment Means $\pm$ SE
	0	5	10	15	
pH					
Chilling	6.18 $\pm$ 0.02a	6.32 $\pm$ 0.03b	6.46 $\pm$ 0.04c	NP	6.32 $\pm$ 0.03
Super chilling	6.18 $\pm$ 0.02a	6.24 $\pm$ 0.02ab	6.30 $\pm$ 0.03b	6.38 $\pm$ 0.03c	6.28 $\pm$ 0.03
Days Means $\pm$ SE	6.18 $\pm$ 0.02a	6.28 $\pm$ 0.03b	6.38 $\pm$ 0.04c	6.38 $\pm$ 0.03 ^c	–
Moisture (%)					
Chilling	64.24 $\pm$ 0.72a	61.82 $\pm$ 0.68b	58.16 $\pm$ 0.75c	NP	61.41 $\pm$ 0.72
Super chilling	64.24 $\pm$ 0.70a	62.86 $\pm$ 0.66b	60.44 $\pm$ 0.72c	58.28 $\pm$ 0.71d	61.46 $\pm$ 0.70
Days Means $\pm$ SE	64.24 $\pm$ 0.71a	62.34 $\pm$ 0.67b	59.30 $\pm$ 0.73c	58.28 $\pm$ 0.71 ^d	–
Moisture retention (%)					
Chilling	60.42 $\pm$ 0.68a	57.18 $\pm$ 0.66b	54.06 $\pm$ 0.70c	NP	57.22 $\pm$ 0.68
Super chilling	60.42 $\pm$ 0.68a	58.96 $\pm$ 0.70b	57.42 $\pm$ 0.72c	55.84 $\pm$ 0.74d	58.16 $\pm$ 0.71
Days Means $\pm$ SE	60.42 $\pm$ 0.68a	58.07 $\pm$ 0.68b	55.74 $\pm$ 0.71c	55.84 $\pm$ 0.74d	–
Oil uptake (%)					
Chilling	8.86 $\pm$ 0.02a	9.18 $\pm$ 0.03b	9.62 $\pm$ 0.03c	NP	9.22 $\pm$ 0.03
Super chilling	8.86 $\pm$ 0.03a	8.94 $\pm$ 0.04ab	9.08 $\pm$ 0.04b	9.22 $\pm$ 0.05c	9.03 $\pm$ 0.04
Days Means $\pm$ SE	8.86 $\pm$ 0.03a	9.06 $\pm$ 0.04b	9.35 $\pm$ 0.04c	9.22 $\pm$ 0.05c	
Free fatty acid (% oleic acid)					
Chilling	0.26 $\pm$ 0.01a	0.48 $\pm$ 0.02b	0.74 $\pm$ 0.02c	NP	0.49 $\pm$ 0.02
Super chilling	0.26 $\pm$ 0.01a	0.34 $\pm$ 0.01ab	0.42 $\pm$ 0.02b	0.52 $\pm$ 0.02c	0.39 $\pm$ 0.02
Days Means $\pm$ SE	0.26 $\pm$ 0.01a	0.41 $\pm$ 0.02b	0.58 $\pm$ 0.02c	0.52 $\pm$ 0.02c	
Tyrosine value (mg tyrosine/100 g)					
Chilling	8.42 $\pm$ 0.22a	12.84 $\pm$ 0.26b	17.62 $\pm$ 0.30c	NP	12.96 $\pm$ 0.26
Super chilling	8.42 $\pm$ 0.22a	10.26 $\pm$ 0.24ab	13.84 $\pm$ 0.28b	17.42 $\pm$ 0.30c	12.48 $\pm$ 0.26
Days Means $\pm$ SE	8.42 $\pm$ 0.22a	11.55 $\pm$ 0.25b	15.73 $\pm$ 0.29c	17.42 $\pm$ 0.30c	
TBA (mg malonaldehyde/kg)					
Chilling	0.18 $\pm$ 0.01a	0.46 $\pm$ 0.02b	0.82 $\pm$ 0.03c	NP	0.49 $\pm$ 0.02
Super chilling	0.18 $\pm$ 0.01a	0.26 $\pm$ 0.01ab	0.38 $\pm$ 0.01b	0.52 $\pm$ 0.02c	0.34 $\pm$ 0.01
Days Means $\pm$ SE	0.18 $\pm$ 0.01a	0.36 $\pm$ 0.02b	0.60 $\pm$ 0.02c	0.52 $\pm$ 0.02c	–

Number of observations: 6

Means with common superscripts did not differ significantly ($P < 0.01$)

Table 2: Changes in microbial quality of chicken cutlets during storage under chilling and super chilling temperatures (Mean $\pm$ S.E)

Treatments	Period (days)				Treatment Mean ± S.E
	0	5	10	15	
Total plate count (log ₁₀ cfu/gm)					
Chilling	2.22 ± 0.07 ^a	3.84 ± 0.08 ^b	4.68 ± 0.08	NP	3.58 ± 0.08
Super chilling	2.22 ± 0.07 ^a	3.12 ± 0.06 ^b	3.86 ± 0.07 ^c	4.42 ± 0.08 ^d	3.40 ± 0.07
Days Means ± SE	2.22 ± 0.07 ^a	3.48 ± 0.07 ^b	4.27 ± 0.08 ^c	4.42 ± 0.08 ^d	
Psychrophilic count (log ₁₀ cfu/gm)					
Chilling	ND	2.84 ± 0.06 ^a	3.72 ± 0.08 ^b	NP	3.28 ± 0.07
Super chilling	ND	2.18 ± 0.05 ^a	2.94 ± 0.06 ^b	3.68 ± 0.07 ^c	2.93 ± 0.06
Days Means ± SE		2.51 ± 0.06 ^a	3.33 ± 0.07 ^b	3.97 ± 0.07 ^c	—
Coliform count (log ₁₀ cfu/gm)					
Chilling	ND	ND	ND	ND	
Super chilling	ND	ND	ND	ND	
Days Means ± SE					
Days Means ± SE					
Yeast and Mould count (log ₁₀ cfu/gm)					
Chilling	2.72 ± 0.18	3.04 ± 0.16 ^{ab}	3.28 ± 0.15 ^b	NP	3.01 ± 0.16
Super chilling	2.72 ± 0.18 ^a	2.88 ± 0.16 ^{ab}	3.04 ± 0.14 ^b	3.22 ± 0.13 ^c	2.97 ± 0.15
Days Means ± SE	2.72 ± 0.18 ^a	2.96 ± 0.16 ^{ab}	3.16 ± 0.15 ^b	3.22 ± 0.13 ^c	

Number of observations: 6

Means with common superscripts did not differ significantly ($P < 0.01$).**Table 3:** Changes in sensory quality of chicken cutlets during storage under chilling (4 ± 1 °C) and super chilling (-1 to -2 °C) temperatures (Mean $\pm$ S.E)

Treatments	Period (days)				Treatment Mean ± S.E
	0	5	10	15	
Appearance					
Chilling	8.42 ± 0.06 ^a	7.62 ± 0.08	6.74 ± 0.10 ^c	NP	7.59 ± 0.08
Super chilling	8.42 ± 0.06 ^a	8.02 ± 0.08 ^{ab}	7.58 ± 0.10 ^b	7.12 ± 0.12 ^c	7.79 ± 0.09
Days Mean ± S.E	8.42 ± 0.06 ^a	7.82 ± 0.08 ^b	7.16 ± 0.10 ^c	7.12 ± 0.12 ^c	
Flavour					
Chilling	8.36 ± 0.08 ^a	7.44 ± 0.10 ^b	6.42 ± 0.12	NP	7.41 ± 0.10
Super chilling	8.36 ± 0.08 ^a	7.96 ± 0.10 ^{ab}	7.38 ± 0.12 ^b	6.94 ± 0.14 ^c	7.66 ± 0.11
Days Mean ± S.E	8.36 ± 0.08 ^a	7.70 ± 0.10 ^b	6.90 ± 0.12 ^c	6.94 ± 0.14 ^c	
Juiciness					
Chilling	8.28 ± 0.08 ^a	7.36 ± 0.10 ^{bb}	6.34 ± 0.12 ^c	NP	7.33 ± 0.10
Super chilling	8.28 ± 0.08 ^a	7.84 ± 0.10 ^{ab}	7.26 ± 0.12 ^b	6.82 ± 0.14 ^c	7.55 ± 0.11
Days Mean ± S.E	8.28 ± 0.08 ^a	7.60 ± 0.10 ^b	6.80 ± 0.12 ^c	6.82 ± 0.14 ^c	
Tenderness					
Chilling	8.34 ± 0.08 ^a	7.52 ± 0.10 ^b	6.58 ± 0.12 ^c	NP	7.48 ± 0.10
Super chilling	8.34 ± 0.08 ^a	7.92 ± 0.10 ^{ab}	7.42 ± 0.12 ^b	6.96 ± 0.14 ^c	7.66 ± 0.11
Days Mean ± S.E	8.34 ± 0.08 ^a	7.72 ± 0.10 ^b	7.00 ± 0.12 ^c	6.96 ± 0.14 ^c	
Overall acceptability					
Chilling	8.40 ± 0.08 ^a	7.48 ± 0.10 ^b	6.52 ± 0.12 ^c	NP	7.47 ± 0.10
Super chilling	8.40 ± 0.08 ^a	8.02 ± 0.10 ^{ab}	7.46 ± 0.12 ^b	7.02 ± 0.14 ^c	7.73 ± 0.11
Days Mean ± S.E	8.40 ± 0.08 ^a	7.75 ± 0.10 ^b	6.99 ± 0.12 ^c	7.02 ± 0.14 ^c	

Number of observations: 36

Means with common superscripts did not differ significantly ($P < 0.01$)

Conclusion

Based on the evaluation of physico-chemical, microbial, and sensory quality characteristics, super chilling storage (-1 to -2 °C) was found to be more effective than conventional chilling storage (4 ± 1 °C) in preserving the quality and extending the shelf life of aerobically packaged chicken cutlets. Integration of the overall quality parameters indicated that chicken cutlets stored under conventional chilling conditions remained microbiologically safe and organoleptically acceptable for up to 10 days. In contrast,

samples stored under super chilling conditions maintained acceptable quality characteristics for up to 15 days. The superior preservation effect of super chilling may be attributed to its ability to retard microbial proliferation, reduce lipid oxidation and delay sensory deterioration by maintaining the product at a sub-zero, non-freezing temperature. Therefore, super chilling can be considered an effective preservation technique for improving the storage stability and extending the commercial shelf life of convenience poultry products.

Conflict of Interest

Not available

Financial Support

Not available

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How to Cite This Article

Oluwafemi RA. Storage stability and shelf life of chicken cutlets under chilling and super chilling temperatures. *International Journal of Veterinary Sciences and Animal Husbandry*. 2026;11(5):251-256.

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