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Study on preservation of chicken keema at refrigerated temperature

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Abstract
To sustain the increased chicken production and utilization of chicken mince production. This research focused on standardizing the formulation for chicken keema and increasing its shelf life using preservatives (citric acid, vinegar, and sodium benzoate) at refrigerated temperatures.
The prepared keema was preserved with different concentrations of citric acid (0.5-1.5%), vinegar (5-15%), and sodium benzoate (100-250 ppm). The keema was packed in retortable pouches and sterilized at 120 ºC for 15-20 min. at 15 PSI pressure. The sterilized keema was stored at a refrigerated condition to study its storage stability and analyzed for physiological, microbiological, biochemical, and sensory attributes at regular intervals of 10 days during storage. During storage, no significant changes were observed in proximate composition except moisture content. However, the control sample spoiled after 10 days of refrigerated storage. An increasing trend was recorded in the pH and TBARS values during the storage of almost all samples. However, the sample preserved with 1% citric acid recorded the lowest TPC (2.2×10^4) after 30 days of storage and was acceptable during sensory evaluation. Thus the shelf life of chicken keema was improved from 10 days to 30 days by the use of 1% citric acid along with the retorting process.

Keywords: Chicken meat, Keema, preservatives, vinegar, citric acid, sodium benzoate

Introduction
Keema is a popular dish preferred by consumers globally in India as well as in Arabian countries. All nations that raise buffalo, including those in Asia, Africa, Australia, Europe, and South America, like traditional buffalo meat products very much. Indian cuisine's traditional and delectable buffalo meat keema is made by simmering minced meat with spices and herbs. The processing style and sensory quality of this product vary due to the wide regional variability. The preference for conventional beef products still prevails among individuals, despite rising urbanization and changes in lifestyle in recent years. Foods made using meat in the traditional Indian style require a lengthy preparation process. The demand for ready-to-eat meat products is expanding in India in order to reduce the stress of processing in the kitchen and to meet the needs of the growing working population (Kandeepan 2010) [33]. Chicken meat is getting an increasing market share in many countries and more consumers are considering product quality when choosing what to buy.
Chicken meat contains higher moisture and a good amount of nutrients, which leads to microbial spoilage and deterioration in quality. To avoid microbiological spoilage and to maintain quality the chicken is converted into different products variety of ways it may be served, chicken is a very famous and healthful cuisine. Chicken dishes include fried chicken, meatballs, sausages, cutlets, steaks, chicken kabab, nuggets, chicken Rezala (Bengal region), Andong jjimadak (Korean dish), grilled chicken, tandoori chicken, homemade chicken soup, canned chicken products, etc.
Chicken meat has high-quality protein, people eat it. The poultry meat composition includes water, protein, fat, ash, calcium, phosphorus, iron, copper, and other components important to eating quality. Poultry meat has a high content of protein around 21%, moisture is about 70-75% and fat is around 2-3% depending on part of the carcass. Poultry meat is a good source of many vitamins, such as niacin (69%), thiamin (Vitamin B6-30%,), riboflavin (Vitamin B12-6%), and ascorbic acid (Vitamin C).

Poultry liver is a rich source of Vitamin A, Vitamin B complex, and Vitamin C (Aymerich *et al*., 2008) [34].

Due to their high water activity and nutrient components, meat and meat products can offer an effective environment for food-borne diseases or spoilage bacteria (Pal *et al*., 2017) [25]. The spoilage in poultry meat is majorly caused due to presence of gram-positive and gram-negative bacteria (Rouger, 2017) [29] and iron, which are oxidation promoters, is present in large percentages in poultry meat. Microbial growth and lipid oxidation are the two main processes that affect the composition of meat, diminish its color, cause a flavor to emerge, alter its texture, and create lipid oxidation products such as malonaldehyde (MDA) and cholesterol oxides (Thomas *et al*. 2008) [32].

Several preservation techniques such as freezing, drying, use of chemicals, and use of high temperatures are employed to prolong the shelf life of poultry meat. In general, either lowering the temperature or heat treatment is commonly used to extend the shelf life of poultry meat. Nowadays retorting is used along with chemicals to preserve poultry meat and its products.

Citric acid improves water-holding capacity and tenderness of meat, inhibits lipid oxidation, and can be used to reduce microscopic contaminants. It improves texture and inhibits lipid oxidation, while vinegar can be used to store and preserve meat in a similar way to its natural state. Sodium benzoate is a popular preservative used in Vietnam and other countries. It has an antimicrobial effect and is used in products with a pH range of 2.5-4.

The chicken mince meat (Keema) is freshly prepared and eaten. The majority of individuals want to eat a healthy diet without fundamentally altering how they eat. Therefore, conventional meat products with increased nutritional features and unaltered sensory qualities must be developed on a commercial basis. However, it is essential that the right technologies be created for their manufacture and packaging if traditional meat-based products are going to be marketed on a large scale. Without using a refrigerator, scientific processing, along with good manufacturing techniques and appropriate packaging, would extend the meat keema's shelf life. However, the quality of keema kept at room temperature for an acceptable amount of time would undoubtedly be different from that kept in a refrigerator for the same time. However, there is no scientific literature is available on the preservation of chicken keema. So in the present research attempts were made to standardize keema preparation and improve the shelf life.

Materials and Methods

Preparation of Raw material

The fresh boneless chicken meat was procured from the chicken retailer of Kolad Dist. Raigad (Maharashtra) is in a fresh and hygienic condition and stored in refrigerated condition before use. It was minced in a meat mincer.

Formulation for keema

The standard formulation suggested by Kandeepan *et al*., 2010 [33] is considered as recipe A, The formulation given by Karthikeyan *et al*., 2000 is considered as recipe B, while recipe C was a slight modification of recipe A and recipe B.

Table 1: Composition of requirements for chicken keema

Ingredients (g)	Recipe C
Coriander powder	1.50
Cumin seeds	0.50
Black pepper	0.20
Degi mirch	3.75
Turmeric	0.75
Onion	37.5
Ginger-garlic paste	7.50
Red chili powder	3.00
Whole spices	0.80
Chicken masala	0.75
Salt	2.00
Oil	18.75

Processing of chicken keema

The boneless chicken meat was cleaned with portable water and subjected to mincing. Add oil, onion, and ginger-garlic paste to pan and roast for 10 min. Add spices mix, salt, and chilli powder in it. In this mixture add minced meat with the required quantity of water to cook on a medium flame for 20-25 min to get keema. Keema was cooled at room temperature and added with the required amount of preservatives. Then packed the product in retortable pouches and sterilized at 120 ℃ for 15 min at 15 PSI pressure. Immediately cool at room temperature using cold water to avoid overheating and then store pouches at 4±1 ℃.

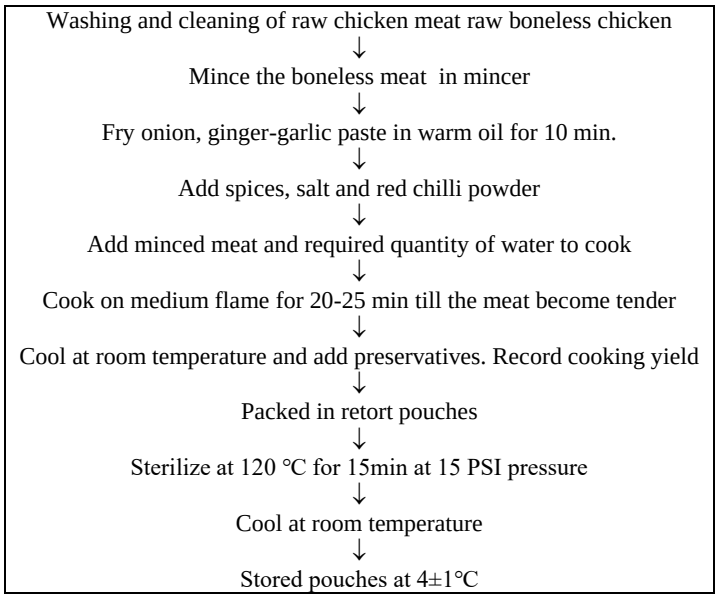

Fig 1: Flow diagram for preparation of chicken keema

Addition of Preservative

The preservatives i.e. citric acid, vinegar, and sodium benzoate were added to chicken keema at different concentrations. The samples were coded as a control sample (T_1), Sample with 0.5% citric acid (T_2), Sample with 1.0% citric acid (T_3), Sample with 1.5% citric acid (T_4), Sample with 5% Vinegar (T_5), Sample with 10% Vinegar (T_6), Sample with 15% Vinegar (T_7), Sample with 100 ppm sodium benzoate (T_8), Sample with 150 ppm sodium benzoate (T_9) and Sample with 250 ppm sodium benzoate (T_{10}).

Physicochemical Analysis

The proximate composition i.e. moisture, protein, fat, ash, and carbohydrate content of keema was determined by AOAC, 2005. The pH was analyzed by a digital pH meter (Model CP 901, Century Instruments Ltd, Chandigarh, India). TBARS was determined by the method suggested by Loovas, 1992, and expressed as mg malonaldehyde/kg of sample.

Microbiological Analysis

All the microbiological parameters of chicken keema were determined as per the methods described by APHA (2001). Plate count agar (PCA) (Hi-Media®, Mumbai, India) for total plate count. The media preparation was 23.5 g per 1000ml of distilled water with incubated at 35°C for 24 hr. The results were expressed as Cfu/10g.

Sensory Evaluation

The freshly prepared chicken keema as well as keema stored at refrigerated conditions was subjected to sensory evaluation by semi-trained panel members using 9 Point hedonic scale. Each panelist was asked to evaluate the sensory characteristics like appearance, texture, flavor, and overall acceptability of each sample (Amerine *et al*., 1965) [35].

Statistical Analysis

The data generated by repeating the experiments for different quality characteristics were compiled and data were analyzed using of variances (ANOVA) tool available in MS-Excel 2021 with a completely randomized block design (CRD). The significant differences were tested by a 5% level of significance and are mentioned as $p < 0.05$ for significance differences (Zar, 1999) [36].

Results and Discussion

Effect of preservatives on physicochemical evaluation during storage at refrigerated temperature

The different preservative and their levels did not show any significant changes in the moisture content of samples. However, a slight increasing trend was observed during storage (Table 2). The maximum increases in moisture were observed in T_6 (64.26%) and the minimum in T_9 (62.41%) after 30 days of storage. The increase in moisture content related to the pH of the product in the present study and similar results were in buffalo meat keema at different storage temperatures (Kandeepan *et al*. 2010) [33].

The protein content of chicken keema exhibited a declining trend line during storage. The maximum protein degradation was noted in sample T_6, i.e. from 20.62% to 19.64%, and the minimum in sample T_5 i.e. from 20.50% to 19.36% (Table 2). The higher level of protein percentage in chicken keema at initial storage was the result of added ingredients in the chicken kheema, in all preservatives of combinations. Similar results were observed by Deepak *et al*. (2017) [37] in chicken nuggets.

No significant change was recorded in the sample stored at refrigerated conditions. The maximum fat content was noted in sample T_4 (15.40%) and the minimum in sample T_5 (15.02%) after 30 days of storage at refrigerated temperature (Table 2). The fat percentage was closely and inversely related to the moisture level of the chicken keema product sample treated with different preservatives. The higher fat content of chicken keema might be due to the oil used for its preparation (Charles, 1982; Mohan *et al*. 1987) [12, 22]. Lower TBA value in treatment samples is due to the antioxidant property of spices mix as well as preservatives, which delay lipid oxidation in comparison to the control sample, where an increase in lipid oxidation and the presence of oxygen during storage. This observation agrees with Brewer *et al*. (1992) [11].

During refrigerated storage, there was a non-significant effect on ash in all treatment combinations in each interval of analysis. Ash content represents the mineral content of the product, which was not much affected by the addition of additives and storage conditions (Bomminayuni *et al*. 2016; Turhan *et al*. 2007; Turhan *et al*. 2005) [10, 38-39].

The carbohydrates were decreased as storage progressed. A significant effect was observed in carbohydrates during storage, the maximum degradation was recorded in sample T_9 (2.35%) whereas the minimum was recorded in T_6 (0.27%) (Table 2). The carbohydrate percentage showed a decreasing trend might be due to changes in other constituents of chicken mince meat.

Biochemical characteristics

Effect of preservatives on pH during refrigerated storage

The pH of all samples was increased during storage. The maximum pH was found in the T_8 (4.6) sample and the minimum was in T_3 (4.4) during 30 days of storage (Table 3). The rise in pH in respective treatments might be due to mesophilic bacterial action on protein molecules which results in alkaline metabolite formation similar results were found. These results were similar to the findings of Sallam *et al*. (2004) [30], who reported that storage time had a significant effect on pH values that increased with storage.

Effect of preservatives on TBARS (mg MDA/g) during refrigerated storage

TBARS is considered a freshness indicator of the oxidation of fat present in the food. The TBARS was significantly increased during storage in all preservative treatments given to keema for shelf life enhancement (Table 3). The overall maximum TBARS in sample T_5 (1.2 mg MDA/g) whereas the minimum was recorded in T_6 (0.25 mg MDA/g). The initial TBARS index may be affected by the fat composition, and type of muscles (Cobos *et al*. 2003) [13]. In foods, unsaturated fatty acids—typically those once esterified to the glycerol backbone of triacylglycerol (TAG) or phospholipid—decompose into volatile compounds with low molecular weights that produce off-aromas associated with rancidity (Labuza and Dugan, 1971) [19].

Effect of Preservatives on Microbiological Quality of Keema during refrigerated storage

Microbial analysis is considered the best method to judge the preservative effect of any preservation technique (Table

4). The maximum growth of Total Plate Count (TPC) was recorded in the T_1 (control) sample after 20 days of storage in a refrigerated condition which is beyond the perishable limit of meat products (100000/g) by FASSAI for human consumption, high total plate count in keema was mainly due to the conducive a_w and pH (Smolka *et al*., 1974; Leistner *et al*., 1981) [31, 21]. So the sample was discarded and not taken for further analysis.

Effect of preservatives on organoleptic quality of keema stored at refrigerated condition

The sensory analysis semi-trained pannels were established. Sensory is one of the most important qualities of judging the affecting consumer's acceptability of food products. All the samples were subjected to sensory analysis for consumer acceptability (Table 5).

The results of refrigerated storage of chicken keema showed a non-significant effect on appearance in all treatment combinations. Chicken minced meat treated sample was showed statistically significant during storage at refrigerated storage all preservatives combinations show slightly dark appearances than early stage of storage this might be due to pigment and lipid oxidation resulting in nonenzymatic brown. A similar result was reported by Kumar and Tanwar (2011) [18] in-ground mustard-incorporated chicken meat nuggets.

The texture is one of the important sensory parameters to know the mouth feel of the product. The chicken keema lost its texture during storage and obtained a lower score as storage progressed. The tenderness was increased during storage, but its original texture was disturbed which might have lowered the sensory score for texture. This variation might be due to attributes to the degree of dehydration of muscle proteins Biswas (2002) [1]. All samples preserved with different preservatives showed a decreasing trend in flavor scores. In 30 days of storage of chicken keema preservatives treated samples perhaps caused deterioration of flavor during refrigerated storage might be due to microbial growth, and oxidative rancidity (Devatkal *et al*. 2003) [14].

The overall acceptability of all samples was reduced as storage was increased. The overall acceptability was statistically decreased in all samples. The declining trend of chicken keema during storage at refrigerated storage of overall acceptability score was strongly supported by Biswas (2002) [1].

Table 2: Effect of preservatives on evaluation of keema samples during refrigerated storage

	Treatment	0 Days	10 Days	20 Days	30 Days
MOISTURE	T_1	59.70±3.9	62±5.2	SD	SD
	T_2	59.27±3.3	59.8±5.2	61.64±3.1	63.56±4.3
	T_3	59.08±4.4	58.78±5.9	63.06±1.9	63.54±4.2
	T_4	58.77±5.8	60.13±5.0	62.03±1.6	63.42±4.7
	T_5	58.78±4.8	60.44±5.3	62.05±0.6	63.56±4.3
	T_6	59.19±3.3	61.66±4.9	63±0.3	64.26±5.5
	T_7	58.48±5.8	60.35±5.2	62.76±0.2	64.13±5.4
	T_8	58.78±4.8	60.44±5.3	61.54±0.1	63.54±4.2
	T_9	57.41±4.3	59.7±3.9	61.57±0.2	62.41±6.2
	T_{10}	58.5±5.9	60.4±5.4	62.78±0.1	SD
PROTEIN	T_1	20.4±1	19.64±1.3	SD	SD
	T_2	19.54±2	19.4±0.9	19.32±1.7	19.03±1.7
	T_3	20.62±1.7	19.98±1.1	19.4±0.9	19.04±1.7
	T_4	20.76±1.4	20.20±2	19.9±1.1	19.05±1.7
	T_5	20.5±1.4	19.74±1.4	19.36±1	19.02±1.3
	T_6	20.62±1.7	19.9±1.1	19.64±1.2	19.2±1.1
	T_7	20.34±2.1	19.65±1.4	19.44±1.1	19.06±1.7
	T_8	21.07±1.6	20.46±1.3	19.94±1.6	19.04±1.3
	T_9	21.35±1.9	20.26±1.1	19.86±1.4	19.05±1.1
	T_{10}	19.97±1.3	19.84±1.1	18.87±1.5	SD
FAT	T_1	15.03±0.15	14.8±0.20	SD	SD
	T_2	14.99±0.28	15.1±0.10	15.2±0.26	15.04±0.02
	T_3	15.2±0.10	15.3±0.10	15.03±0.2	15.09±0.12
	T_4	15.03±0.02	15.3±0.10	15.2±0.26	15.4±0.2
	T_5	15.2±0.26	15.1±0.07	15.05±0.05	15.02±0.05
	T_6	15.03±0.02	15.0±0.02	15.03±0.02	15.32±02
	T_7	15.3±0.10	15.3±0.10	15.4±0.20	15.18±0.05
	T_8	15.07±0.07	15.1±0.10	15.09±0.12	15.12±0.04
	T_9	15.03±0.02	15.2±0.26	15.24±0.02	15.23±0.17
	T_{10}	15.2±0.26	15.1±0.02	14.95±0.1	SD
ASH	T_1	0.94±0.01	0.95±0.02	SD	SD
	T_2	0.96±0.02	0.95±0.01	0.96±0.01	0.95±0.02
	T_3	0.94±0.01	0.95±0.02	0.94±0.01	0.95±0.01
	T_4	0.96±0.02	0.97±0.01	0.96±0.02	0.94±0.01
	T_5	0.94±0.01	0.95±0.02	0.94±0.01	0.93±0.02
	T_6	0.96±0.02	0.95±0.01	0.96±0.02	0.95±0.03
	T_7	0.95±0.02	0.96±0.01	0.95±0.01	0.95±0.01
	T_8	0.94±0.01	0.95±0.02	0.94±0.02	0.95±0.02
	T_9	0.96±0.02	0.95±0.01	0.96±0.01	0.96±0.01
	T_{10}	0.96±0.01	0.97±0.01	0.96±0.02	SD

CARBOHYDRATES	T_1	3.93±0.01	2.61±0.01	SD	SD
	T_2	5.24±0.03	4.75±0.03	2.88±0.02	1.42±0.02
	T_3	4.16±0.03	4.99±0.29	1.57±0.01	1.38±0.03
	T_4	4.48±0.02	3.4±0.10	1.91±0.05	1.19±0.01
	T_5	4.58±0.04	3.75±0.01	2.6±0.10	1.47±0.04
	T_6	4.2±0.05	2.45±0.03	1.37±0.01	0.27±0.01
	T_7	4.93±0.03	3.74±0.01	1.45±0.03	0.68±0.05
	T_8	4.14±0.01	3.05±0.09	2.49±0.01	1.35±0.01
	T_9	5.25±0.02	3.89±0.01	2.37±0.04	2.35±0.01
	T_{10}	5.37±0.01	3.68±0.02	2.44±0.03	SD

T_1 = Control, T_2 = 0.5% citric acid, T_3 = 1% citric acid, T_4 = 1.5% citric acid, T_5 = 5% Vinegar, T_6 = 10% Vinegar, T_7 = 15% Vinegar, T_8 = 100 ppm Sodium benzoate, T_9 = 150 ppm Sodium benzoate, T_{10} = 250 ppm Sodium benzoate

Table 3: Effect of preservatives on pH of keema samples during refrigerated storage

	Treatment	0 Days	10 Days	20 Days	30 Days
pH	T_1	4.4±0.3	4.5±0.2	SD	SD
	T_2	3.9±0.2	4.2±0.1	4.3±0.2	4.5±0.5
	T_3	3.9±0.1	4.0±0.2	4.2±0.1	4.5±0.2
	T_4	3.7±0.1	4.1±0.2	4.3±0.2	4.4±0.2
	T_5	3.8±0.2	4.2±0.1	4.3±0.2	4.6±0.6
	T_6	3.8±0.2	4.0±0.2	4.2±0.2	4.5±0.2
	T_7	3.7±0.1	4.1±0.2	4.3±0.2	4.4±0.2
	T_8	3.9±0.1	4.2±0.1	4.4±0.2	4.6±0.6
	T_9	3.9±0.2	4.1±0.1	4.2±0.1	4.4±0.1
	T_{10}	3.7±0.1	4.0±0.2	4.3±0.3	SD
TBARS	T_1	0.23±0.02	1.45±0.1	SD	SD
	T_2	0.16±0.01	0.57±0.04	0.61±0.04	0.81±0.04
	T_3	0.45±0.03	0.54±0.03	0.56±0.03	0.69±0.01
	T_4	0.16±0.01	0.26±0.04	0.69±0.02	1.02±0.05
	T_5	0.16±0.03	0.26±0.02	0.69±0.01	1.20±0.20
	T_6	0.45±0.03	0.51±0.01	0.62±0.01	0.25±0.01
	T_7	0.58±0.06	0.61±0.03	0.69±0.05	1.02±0.02
	T_8	0.39±0.03	0.45±0.01	0.56±0.02	0.61±0.01
	T_9	0.42±0.01	0.46±0.04	0.52±0.03	0.66±0.04
	T_{10}	0.51±0.03	0.58±0.01	1.45±0.01	SD

SD = Sample Discarded, T_1 = Control, T_2 = 0.5% citric acid, T_3 = 1% citric acid, T_4 = 1.5% citric acid, T_5 = 5% Vinegar, T_6 = 10% Vinegar, T_7 = 15% Vinegar, T_8 = 100 ppm Sodium benzoate, T_9 = 150 ppm Sodium benzoate, T_{10} = 250 ppm Sodium benzoate.

Table 4: Effect of preservatives on TPC (log cfu/g) during refrigerated storage on

	Treatments	0 Days	10 Days	20 Days	30 Days
Total Plate Count	T_1	3.03±0.01	4.32±0.1	SD	SD
	T_2	3.14±0.01	4.27±0.1	4.34±0.10	4.39±0.10
	T_3	3.07±0.01	4.14±0.01	4.23±0.10	4.34±0.10
	T_4	3.04±0.01	4.23±0.01	4.27±0.02	4.32±0.20
	T_5	3.14±0.01	4.25±0.02	4.38±0.10	4.5±0.20
	T_6	3.07±0.01	4.3±0.20	4.38±0.10	4.5±0.03
	T_7	3.07±0.01	4.25±0.02	4.36±0.10	4.48±0.06
	T_8	3.02±0.01	4.07±0.01	4.32±0.10	4.43±0.05
	T_9	3.25±0.01	4.32±0.01	4.31±0.10	4.47±1.31
	T_{10}	3.25±0.01	4.35±0.01	5.71±0.10	SD

SD = Sample Discarded, T_1 = Control, T_2 = 0.5% citric acid, T_3 = 1% citric acid, T_4 = 1.5% citric acid, T_5 = 5% Vinegar, T_6 = 10% Vinegar, T_7 = 15% Vinegar, T_8 = 100 ppm Sodium benzoate, T_9 = 150 ppm Sodium benzoate, T_{10} = 250 ppm Sodium benzoate.

Table 5: Effect of preservatives on organoleptic quality of keema stored at refrigerated condition

	Treatments	0 Days	10 Days	20 Days	30 Days
Appearance	T_1	7.8±0.49	6.7±0.58	SD	SD
	T_2	7.4±0.26	7.2±0.72	7.5±0.10	7.6±0.10
	T_3	7.3±0.20	7.4±0.78	7.5±0.15	7.7±0.15
	T_4	7.5±0.32	7.1±0.61	7.3±0.10	7.1±0.10
	T_5	7.7±0.42	8±1.53	7.4±0.12	7±0.12
	T_6	7.4±0.23	8.2±1.27	7.2±0.10	7.5±0.10
	T_7	7.5±0.26	7.4±0.78	7.2±0.10	7.2±0.15
	T_8	7.6±0.36	7.6±0.95	7.7±0.12	6.9±0.10
	T_9	7.4±0.26	7.7±0.95	7±1.00	7.1±0.12
	T_{10}	7.5±0.26	7.2±0.72	6.5±0.10	SD
Texture	T_1	8±0.50	6.8±0.32	SD	SD
	T_2	7.7±0.10	7.6±0.38	7.5±0.31	7.6±0.10
	T_3	7.6±0.42	7.8±0.21	7.7±0.10	7.8±0.21
	T_4	7.4±0.10	7.7±0.10	7.2±.020	7±0.23
	T_5	7.6±0.10	7.6±0.10	7.5±0.15	7.1±0.21
	T_6	7.4±0.26	7.8±0.44	7.1±0.10	7.4±0.10
	T_7	7.7±0.10	7.7±0.32	6.9±0.10	7±0.10
	T_8	7.4±0.26	7.3±0.10	7.7±0.42	6.9±0.26
	T_9	7.6±0.10	7.1±0.21	7.4±0.10	6.8±0.10
	T_{10}	7.4±0.10	7.1±0.10	6.2±0.47	SD
Flavour	T_1	7.9±0.26	6.8±0.49	SD	SD
	T_2	7.3±0.15	7.5±0.26	7.4±0.10	7.2±0.50
	T_3	7.2±0.26	7.5±0.20	7.8±0.21	7.5±0.10
	T_4	7.1±0.10	7.2±0.32	7.4±0.23	7.2±0.32
	T_5	7.7±0.10	7.5±0.42	7.3±0.10	7±0.31
	T_6	7.2±0.23	7.4±0.42	7.3±0.26	7.4±0.23
	T_7	7±0.15	7.1±0.23	7.2±0.15	7.1±0.26
	T_8	7.5±0.32	7.6±0.26	7.5±0.10	6.8±0.10
	T_9	7.5±0.21	7.4±0.36	7.6±0.21	6.9±0.15
	T_{10}	7.4±0.12	7.1±0.23	5.4±0.12	SD
Overall Acceptability	T_1	7.5±0.44	6.5±0.15	5.5±0.58	SD
	T_2	6.9±0.12	7.6±0.21	7.2±0.72	7.4±0.10
	T_3	6.3±0.15	7.8±36	7.4±0.78	7.8±0.36
	T_4	7±0.36	7.6±0.26	7.2±0.61	7.2±0.15
	T_5	7.3±0.21	7.3±0.10	7.6±0.78	7.1±0.10
	T_6	7.5±0.12	7.9±0.15	7.2±0.95	7.5±0.12
	T_7	6.9±10	7.8±0.20	7.1±0.72	7±0.26
	T_8	7.1±0.10	7.6±0.23	7.6±0.23	6.4±0.31
	T_9	7.3±0.21	7.6±0.23	7.3±0.36	6.7±0.23
	T_{10}	7.3±0.20	7±0.12	5.5±0.46	SD

T_1 = Control, T_2 = 0.5% citric acid, T_3 = 1% citric acid, T_4 = 1.5% citric acid, T_5 = 5% Vinegar, T_6 = 10% Vinegar, T_7 = 15% Vinegar, T_8 = 100 ppm Sodium benzoate, T_9 = 150 ppm Sodium benzoate, T_{10} = 250 ppm Sodium benzoate

Conclusions

In the present study, the method for the preparation of chicken keema was standardized. Chicken keema can be preserved for 30 days using chemical preservatives. The sensory quality of chicken keema revealed that appearance, flavor, texture, and overall acceptance retain for up to 30 days during storage in refrigerated condition. Based on sensory evaluation and other analyses of chicken keema, it is concluded that chicken keema treated with T_3 (citric acid 1%) records better results compared to other treated samples.

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