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Studies on Ready-To-Eat mutton kheema incorporated with prune puree under refrigeration study

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ABSTRACT

A study was undertaken to standardize mutton kheema with non-meat ingredients in the first stage. In the second stage incorporation of prune puree at 3 different levels viz., 10%, 15% and 20% was carried out to find out a desired level. Based on the sensory score 15% level of prune puree was taken as the best level and further studies were undertaken by packaging in aerobic and nitrogen flush packages in metallized LDPE pouches. The aerobic and nitrogen packages of mutton kheema were subjected to refrigerated storage for 20 days. The product was evaluated for physico-chemical, microbial and sensory quality at intervals of 0, 5, 10, 15 and 20 for refrigerated storage. There was a significant increase in the moisture content of mutton kheema when prune puree is incorporated at 15% level. The protein and total ash contents did not change but there is increase in crude fat content. There was a significant increase in the pH, TBARS, Tyrosine and %FFA content as the storage progressed for 0-20 days in refrigeration storage. There was a significant decrease in pH, TBARS values, Tyrosine value and % FFA with incorporation of prune puree. Nitrogen flush packaged mutton kheema recorded significantly lower pH, TBARS, Tyrosine value and FFA content irrespective of storage and treatments.

KEYWORDS

Mutton kheema;
Prune puree;
pH;
TBARS;
Tyrosine and %FFA content.

INTRODUCTION

Sheep meat (mutton) is a good source of valuable nutrients. Unlike pork and beef, it has no social taboos and is consumed by all the religions in the country, thus making it the most preferred meat in India. Keema, Kheema, or Qeema is a traditional South Asian meat dish. Originally this word meant minced meat[1] In South Asia, both lamb (mutton) and goat meat (chevon) are also minced to produce kheema. Kheema is a traditional indigenous and delicious meat product of India prepared by cooking minced meat with spices and seasonings. A variety of plant materials (Fruits and vegetables) have been used as fat replacers, binders and extenders in comminuted meat products[2]. However, the incorporation of fruits and vegetables in processing of meat products relates to their functional properties such as water binding, fat emulsification, yield and their sensory properties. In this context, prunes are considered as healthy food because of lower fat content and contain considerable amount of important nutrients like carbohydrates, vitamins and minerals. Prunes and

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prune products also possess medicinal value. Consumption of fruits, like plums and prunes, is useful in blood circulation problems, measles, digestive problems, in prevention of cancer, diabetes and obesity. Plum derived food ingredients have been reported to function as antioxidants, antimicrobials, fat replacers and flavourings[3]. Dried plum puree contains chemical compounds that serve specific functions in foods, pectin aids in moisture retention, while malic acid enhances flavor and sorbitol acts as a natural humectant[4]. Keeping in view the beneficial effects of prunes on human health and nutrition, it is intended to incorporate prune puree into meat products (Kheema) at different levels. Packaging is crucial for maintenance of quality and protect against damage and microbial contamination[5]. Appropriate method should be chosen according to the type of the product. In modified atmosphere packaging (MAP), the atmosphere inside the package is modified in such a way to extend the shelf life of meat while retaining its colour and flavor. The air in package is suitably replaced by gases usually nitrogen, oxygen or carbon dioxide alone or in combination. Modified atmosphere combined with low temperature delays the deleterious effect and maintains the quality of chilled stored meat for extended periods.

Most people would like to eat a healthier diet without fundamentally changing their eating patterns. Thus there is need for the development of traditional meat products on commercial scales with improved nutritional characteristics and unchanged sensory attributes. However, if traditional meat based products are proposed to be marketed on commercial scales, it becomes imperative that suitable technologies be developed for their production and packaging. Scientific processing, accompanied by good manufacturing practices, suitable packaging and storage conditions would definitely improve the shelf life of kheema.

MATERIALS AND METHODS

Mutton kheema was procured from the retail outlet (Royal mutton shop, Hyderabad) due care was taken during its processing as per scientific method and was immediately transported to the Department of Livestock Products Technology, College of Veterinary Science (C.V.Sc), Rajendra Nagar in chilled condition (Thermo coal box) for further processing. Dried plums were brought from local market (Balaji Grand Bazaar, Attapur, Hyderabad). Driedplums were soaked in water (ratio of 1:2 of plum to water) for 12h at 4°C and mashed in a mixer grinder (REMI, Auto-Mix-Blender) to obtain prune puree. Common salt, Vegetable oil, Red chilly powder, ingredients for spice mix, onion, ginger and garlic were procured from the local market of Hyderabad. Thespiceingredients as indicated in TABLE 1 werepurchasedfromthelocalmarket and were cleaned anddriedinthehotairovenat80°Cfor3hours. The ingredients weregroundseparately in a home mixer (REMI, SUPER MIXER GRINDER) and sieved througha fine mesh. The powders were mixed in suitable proportions (TABLE 1) to obtain the spice mix and were storedatroomtemperature in air tight container untiluse.

TABLE 1 : Composition of Dry spice mix

Spice	Parts
Caraway seed (Ajowain)	160
Blackpepper (Kali mirchi)	140
Coriander powder (Dhania)	130
Aniseed (Soanf)	130
Cumin seed (Zeera)	120
Capsicum (Redchillipowder)	100
Cardamom (Badaelaichi)	50
Cinnamom (Dal chini)	50
Turmeric (Haldi)	50
Nutmeg (Jaiphal)	25
Mace (Javithri)	25
Cloves (Laung)	20
Total	1000

Preparation of mutton kheema

Kheema was prepared with the minced mutton precooked in pressure cooker with required quantity of water (10%) for 20 min. Onion, ginger and garlic paste, salt and spice mix were fried in refined vegetable oil in order in proportions as indicated in the standardized recipe in TABLE 2. Precooked minced mutton was added and cooked for 20 min to make it tender and cooled to room temperature.

This study was undertaken to incorporate different levels of Prune puree in the standardized recipe of mutton kheema to evaluate the effect of incorporation on organoleptic characteristics of the products. The mutton

kheema incorporated with different levels of prune puree prepared was evaluated organoleptically as described by Keeton (1983) using semi trained panelists consisting of teaching faculty and post graduate students of C.V.Sc, Hyderabad. The panelists were explained about the nature of experiment without disclosing the identity of the samples. They were requested to record their preference on the standard proforma (Annexure no. 1). Mutton kheema was heated in oven to desirable temperature to serve hot. Warm water and bland biscuits were used as neutralizers for evaluating between samples.

TABLE 2 : Standardized recipe of the control and treatment products (kheema)

Ingredients	Control (%)	Treatment (%)
Water	10	10
Oil	10	10
Wet condiment mix*	10	10
Salt	1.5	1.5
Dry spice mix	2	2
Red chilly powder	0.2	0.2
Prune puree	--	15

***onion, garlic and ginger paste (3:1:1)**

Proximate composition

Themoisture, fat, protein and ash content of the mutton kheema prepared with or without incorporation of prune puree were determined using the techniques recommendedby

Physico- chemical properties

pH, TBARSvalue, Tyrosine value and %FFA were estimated according to the procedures laid by[6,7] respectively for the product at different storage intervals during refrigeration.

Microbiological profile

Themicrobial quality of the kheema was evaluated by estimating the Standard plate count (SPC), psychrophilic count (PPC) and yeast & mould counts (Y&M) following pour plating technique as per the standard procedure of APHA.

Sensory evaluation

Several preliminary trials were conducted to standardize the recipe and procedure to prepare mutton kheema with various non-meat ingredients namely dry spice mix, condiments, red chilly powder, salt and water to select a desirable combination based on sensory evaluation using trained and semi-trained panelists.

This study was undertaken to incorporate different levels of Prune puree in the standardized recipe of mutton kheema to evaluate the effect of incorporation on organoleptic characteristics of the products. Mutton kheema was prepared as per the standardized recipe of Experiment I. To the cooked kheema, prune puree was incorporated at10, 15 and 20 per cent levels, and cooked for 15 min. and the products was evaluated to select the best level of incorporation based on sensory evaluation.

The kheema thus prepared was evaluated organoleptically for appearance, flavor, juiciness, texture, mouth coating and overall acceptability using 9-pointhedonic scale (where, 9is very excellent and1is extremely poor) as described by using trained and semi trained panelists[8].

Statistical analysis

Each experiment was conducted three times and the data was analyzed using SPSSversion20.0 of windows, SPSS Chicago. The data on all parameters are analyze dusing one way ANOVA analysis. The data were subjected to analysis of variance, least significant difference and paired

T-test for comparing the means to find the difference between treatments/ groups and storage period. The smallest difference for two means to be significantly ($P<0.05$) different was reported.

RESULTS AND DISCUSSION

The kheema thus prepared was evaluated organoleptically for appearance, flavor, juiciness, texture, mouth coating and overall acceptability using 9-pointhedonic scale (where, 9 is very excellent and1is extremely poor). There was no difference statistically in all the organoleptic attributes viz., appearance, flavor, juiciness, mouth coating, texture and overall acceptability between control and the prune puree incorporated samples at different levels (10%, 15% and 20%). The mutton kheema incorporated with15% prune puree uniformly recorded higher scores though not statistically significant for all the attributes at par with the control.[9].

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reported that injection of plum ingredients up to 5% into beef roast had minimal effect on appearance. Increasing prune puree in the formulation there was an increased juiciness and texture scores were observed. However, no such increase in other sensory attributes was recorded in the present study. Increased texture and juiciness was attributed to the presence of sorbitol, which naturally binds moisture and potential to alleviate the juiciness[10]. Texture and juiciness scores of 15% prune puree samples were relatively higher than the other products, which are in accordance with findings of who incorporated plum puree (5%, 10% and 15%) in low fat beef patties. Overall acceptability was slightly lower in control samples and the most acceptable sample was that with 15% prune puree[11].

Effects of prune puree incorporation (15%) on the moisture, protein, fat and ash values of mutton kheema as compared to the mutton kheema without prune puree (control) is presented in TABLE 4.

There was a significant reduction in the moisture content of the mutton kheema incorporated with prune puree at 15% level compared to control. However, the

TABLE 3 : Effect of incorporation of prune puree on the organoleptic quality of Mutton Kheema (Mean±SE)

Sample	Appearance	Flavour	Juiciness	Mouth Coating	Texture	Overall Acceptability
Control	8.09±0.02	8.29±0.03	8.08±0.02	8.02±0.01	8.01±0.02	8.11±0.01
10%	8.06±0.01	8.21±0.02	8.10±0.01	8.13±0.02	8.03±0.03	8.02±0.02
15%	8.08±0.01	8.28±0.01	8.12±0.01	8.21±0.01	8.05±0.02	8.16±0.01
20%	7.98±0.01	8.19±0.01	8.17±0.03	8.15±0.01	8.08±0.01	7.99±0.01

TABLE 4 : Effect of incorporation of 15% prune puree on the Proximate composition of Mutton Kheema (Mean±SE)

Proximate characteristic	Control	Treatment (15%)
Moisture (%)	57.48 ± 0.14^{b}	54.13 ± 0.28^{a}
Protein (%)	19.82 ± 0.06^{a}	20.21 ± 0.04^{a}
Fat (%)	17.34 ± 0.12^{a}	19.47 ± 0.10^{b}
Ash (%)	2.30 ± 0.02^{a}	2.41 ± 0.01^{a}

Mean values bearing different superscripts differ significantly (P< 0.05)

crude protein and total ash content did not change by the incorporation of prune puree at 15% level. Crude fat increased as compared to control. Similar findings were reported by in low fat beef patties incorporated with different levels of plum puree (5%, 10% and 15%), which might be attributed to higher moisture content of plum puree against prune puree (dried plum) used in this study. This decrease in moisture might have relatively increased the crude fat content[12].

Physico- chemical properties

pH

As refrigerated storage period progressed from 0 to 20 days, the mean pH values were significantly ($P<0.05$) increased irrespective of treatment and packaging, which may be due to the degradation of lactate, deamination of products and the accumulation of metabolites by bacterial action in meat and deamination of products which reflected in the increase in Standard plate counts. A similar observation of increase in pH during storage was also noted by in hurdle treated chevonkheema stored at ambient temperature[13]. Treatment group viz. TA and TN recorded significantly ($P<0.05$) lower pH values compared to control group (CA and CN),It may be due to the acidic nature of prune puree, due to malic acid (predominant acid), citric, tartaric, benzoic and boric acid, which might have decreased the pH of mutton kheema. The pH values of treatment group were significantly ($P<0.05$) lower than control group. The pH values of mutton kheema packed in aerobic condition were significantly ($P<0.05$) higher compared to nitrogen flush package. Similar findings of decrease in pH were also reported in beef patties incorporated with plum puree at different levels by Yıldız-Turp and

Serdaroglu (2010).

Thiobarbituric acid reactive substances (TBARS) value

Treatment and nitrogen flush packaging significantly ($P<0.05$) affected the TBARS values (mg malonaldehyde/kg) of mutton kheema. There was a significant ($P<0.05$) increase in TBA value as storage period progressed from 0 to 20 days. This might be due to the intensity of lipid oxidation enhanced and production of more secondary products of lipid oxidation formed from the decomposition of oxidized lipid molecules which yield more TBARS values in the mutton kheema. TBARS values of aerobically packed mutton kheema (CA and TA) were significantly ($P<0.05$) higher compared to nitrogen flush packed mutton kheema (CN and TN). Throughout the storage study, TN samples showed significantly ($P<0.05$) lower TBARS value than other products. The antioxidant property of prune puree mainly due to polyphenolic phytochemicals such aschlorogenic acid, neochlorogenic acid, caffeic acid, coumaric acid, rutin[14]. Furthermore, proanthocyanidins are direct scavengers of reactive oxygen species and have the ability to chelate metal ions such as iron. This may be attributed to the very inert nature of the nitrogen, which prevents oxidation, polymerization and isomerization of fatty acids present in the fat. However, the TBARS values recorded for the mutton kheema for control as well as treatment are below the threshold values in terms of mg MDA/ kg sample.

Effect of incorporation of prune puree and packaging on the physico-chemical characteristics of mutton kheema under refrigerated storage (4±1°C) (Mean±SE).

PARAMETER	TREATMENT /GROUPS	STORAGE DAYS				
		0	5	10	15	20
pH	CA	6.06 ± 0.06^{bA}	6.07 ± 0.06^{cA}	6.14 ± 0.01^{cB}	6.25 ± 0.00^{cC}	6.36 ± 0.01^{cD}
	CN	6.06 ± 0.06^{bA}	6.08 ± 0.03^{cAB}	6.10 ± 0.01^{bB}	6.21 ± 0.01^{bC}	6.32 ± 0.01^{cD}
	TA	5.57 ± 0.06^{aA}	5.65 ± 0.04^{bB}	5.73 ± 0.01^{aC}	5.85 ± 0.01^{aD}	5.98 ± 0.01^{bE}
	TN	5.57 ± 0.06^{aA}	5.61 ± 0.05^{aB}	5.74 ± 0.01^{aC}	5.83 ± 0.00^{aD}	5.90 ± 0.02^{aE}
TBARS(mg/Kg)	CA	0.64 ± 0.01^{bA}	0.93 ± 0.00^{dB}	1.19 ± 0.02^{dC}	1.53 ± 0.02^{dD}	1.71 ± 0.00^{dE}
	CN	0.64 ± 0.01^{bA}	0.74 ± 0.01^{bB}	0.92 ± 0.01^{bC}	1.05 ± 0.12^{bD}	1.23 ± 0.01^{bE}
	TA	0.44 ± 0.01^{aA}	0.86 ± 0.00^{cB}	1.05 ± 0.00^{cC}	1.37 ± 0.01^{cD}	1.55 ± 0.01^{cE}
	TN	0.44 ± 0.01^{aA}	0.70 ± 0.00^{aB}	0.84 ± 0.00^{aC}	0.92 ± 0.00^{aD}	$0.96\pm.00^{aE}$
TYROSINE(mg/100g)	CA	8.25 ± 0.77^{bA}	10.758 ± 0.05^{cB}	12.46 ± 0.07^{dC}	14.78 ± 0.04^{dD}	18.46 ± 0.14^{dE}
	CN	8.25 ± 0.77^{bA}	10.36 ± 0.07^{bB}	11.29 ± 0.14^{bC}	12.66 ± 0.05^{bD}	16.20 ± 0.08^{bE}
	TA	7.33 ± 0.13^{aA}	10.38 ± 0.01^{bB}	11.82 ± 0.07^{cC}	13.55 ± 0.08^{cD}	17.24 ± 0.13^{cE}
	TN	7.33 ± 0.13^{aA}	9.95 ± 0.15^{aB}	10.30 ± 0.08^{aC}	11.78 ± 0.07^{aD}	14.52 ± 0.09^{aE}
FFA(%)	CA	0.156 ± 0.12^{bA}	0.212 ± 0.05^{dB}	0.227 ± 0.01^{dC}	0.268 ± 0.02^{dD}	0.283 ± 0.01^{dE}
	CN	0.156 ± 0.09^{bA}	0.186 ± 0.07^{bB}	0.213 ± 0.02^{bC}	0.242 ± 0.03^{bD}	0.258 ± 0.02^{bE}
	TA	0.154 ± 0.08^{aA}	0.197 ± 0.01^{cB}	0.223 ± 0.01^{cC}	0.256 ± 0.02^{cD}	0.275 ± 0.01^{cE}
	TN	0.154 ± 0.06^{aA}	0.176 ± 0.02^{aB}	0.196 ± 0.05^{aC}	0.232 ± 0.02^{aD}	0.248 ± 0.02^{aE}

Means with different superscripts in a row (upper case letters) and in a column (lower case letters) differ significantly (P< 0.05)

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Tyrosine value

There was a significant (P<0.05) increase in tyrosine values, as storage period progressed from 0 to 20 days under refrigeration. The major cause for this increase might be due to proteolysis produced by either microbial growth or chemical reaction[15]. These results are in agreement with the findings of who reported increase in tyrosine value of buffalo meat samples stored under refrigeration. In general, a significantly (P<0.05) lower Tyrosine values were recorded for nitrogen flush packaged mutton kheema compared to aerobically packaged mutton kheema. This may be attributed to low microbial growth and reduced proteolysis in nitrogen packed samples in comparison to aerobically packed samples. Even at the 20th day of refrigerated storage; significantly lowest tyrosine value was noticed in TN than other products.

Percent free fatty acid (FFA)

There was a significant (P<0.05) increase in percent FFA, as storage period progressed from 0 to 20 days, irrespective of treatment and packaging. The increased FFA values during storage might be due to microbial lipolytic activity and oxidative degradation of polyenolic fatty acids. The percent FFA was significantly (P<0.05) lower in nitrogen flush packaged mutton kheema compared to aerobically packaged ones. This may be due to efficient control of the lipid oxidation by nitrogen flush. These results are in agreement with the findings of in Milano-type fermented in dry fermented sausage, stored at 22 and 37 °C in both vacuum and 100% N_2 atmosphere[16].

Microbiological profile

Themicrobial quality of the kheema was evaluated by estimating the Standard plate count (SPC), psychro philic count (PPC) and yeast & mould counts (Y&M) following pour plating technique as per the standard procedure of APHA.

Standard plate count (SPC)

There is a significant (P<0.05) increase in the standard plate counts as the storage period progressed from 0 to 20 days, irrespective of treatment and packaging. In general, mutton kheema packed in nitrogen flush pack (CN and TN) recorded significantly (P<0.05) lower counts than aerobically packed mutton kheema (CA and TA). This might be due to inert atmosphere (N_2 gas flush) which limits the growth of the aerobic microorganisms and plum consists of high in phenolic compounds may inhibit growth of microorganisms at a concentration of 2.6 to 5.6 mg/ml. At the end of refrigerated storage period, among all the groups, TN recorded significantly (P<0.05) lower SPC count.

Yeast and mould counts

Yeast and mould counts were not detected at 0 day of all groups but the counts increased as the storage period progressed from 5 to 20 days. There was a significant (P<0.05) increment in yeast and mould counts from 5th day onward still the end of the refrigerated storage. This increase might be due to relative availability of conducive temperature and moisture for the growth of yeast and moulds. In general, nitrogen flush packed mutton kheema (CN and TN) recorded a significantly (P<0.05) lower yeast and mould counts compared to aerobically packed mutton kheema (CA and TA). Among all the groups, TN samples showed (P<0.05) lower yeast and mould counts, at 20th day of refrigerated storage period. This decrease of yeast and mould counts of nitrogen flush packed samples might be due to protective atmosphere (N_2 flush) which limits the growth of yeast and mould, phenolic compounds and sorbic acid present in prune puree which may inhibit the growth of microorganisms. Similar observations were made by (Lee et al. 1983) invacumm or nitrogen packed veal chucks and by in nitrogen packed frankfurters.

Psychrophilic counts

No psychrophilic counts were detected in control (CA and CN) and treated mutton kheema (TA and TN) during the entire storage period in both refrigeration temperature. This might be due to the thermal processing, packaging and storage conditions to which the mutton kheema is subjected to refrigerated and frozen storage. These results are in accordance with the study of in the microbial flora of pork packed in carbon dioxide and nitrogen atmosphere.

Sensory evaluation

The kheema thus prepared was evaluated organoleptically for appearance, flavor, juiciness,

Effect of incorporation of prune puree and packaging on the Microbiological characteristics of Mutton Kheema under refrigerated storage (4±1°C) (Mean±SE)

SPC	CA	3.35±0.02^{bA}	3.75±0.02^{cB}	4.00±0.01^{dC}	4.08±0.02^{cD}	4.16±0.01^{cE}
	CN	3.35±0.02^{bA}	3.46±0.00^{bB}	3.74±0.04^{cC}	3.88±0.03^{bD}	3.94±0.00^{bD}
	TA	3.00±0.01^{aA}	3.43±0.02^{bB}	3.62±0.01^{bC}	3.83±0.03^{bD}	3.88±0.00^{bD}
	TN	3.00±0.01^{aA}	3.09±0.02^{aA}	3.28±0.01^{aB}	3.51±0.03^{aC}	3.61±0.05^{aD}
Yeast &mould	CA	ND	3.61±0.05^{dA}	3.64±0.11^{dA}	3.83±0.01^{dB}	3.97±0.01^{dC}
	CN	ND	3.33±0.00^{cA}	3.48±0.04^{cB}	3.50±0.01^{cB}	3.65±0.01^{cC}
	TA	ND	3.15±0.01^{bA}	3.30±0.01^{bB}	3.34±0.00^{bC}	3.44±0.00^{bD}
	TN	ND	2.98±0.04^{aA}	3.15±0.01^{aB}	3.25±0.00^{aC}	3.34±0.01^{aD}

texture, mouth coating and overall acceptability using 9-pointhedonic scale (where, 9is very excellent and1is extremely poor) as described by using trained and semi trained panelists.

In general, all the products were scored between 8 & 7 i.e. rated as excellent to very good except for the appearance which was rated as Good (6). It was observed that the scores decreased significantly (P<0.05) with increase in storage periods under both refrigeration temperature. These results are in congruent with in hurdle treated in buffalo meat kheema stored at different temperatures. Mutton kheema incorporated with prune puree and packed under nitrogen flush recorded significantly higher scores for all the sensory attributes viz., appearance, flavour, juiciness, mouth coating, texture and overall acceptability during entire period of refrigeration storage. Similarly nitrogen flush packaged mutton kheema, both control and treatment samples scored higher organoleptic scores than aerobically packaged mutton kheema samples which preserved the flavor and the aroma is maintained. These observations are in agreement with the findings of who reported a significant increase in flavour scores with incorporation of plum puree at 10% level. It is observed that the mutton kheema was not spoiled in terms of any off odour/flavour during the entire period of storage of 20 days of refrigeration storage.

Appearance

The appearance scores of mutton kheema from 0 to 20 days were found to decrease significantly (P<0.05) with increase in days of storage. However, no significant difference was observed between different groups of mutton kheema at any given day of study.

Flavour

The flavour scores of mutton kheema recorded at different storage intervals during refrigeration is presented in TABLE 19. In general there was a significant (P<0.05) decrease in flavour scores as storage period progressed. During the entire period of storage nitrogen flush packaged mutton kheema had significantly (P<0.05) higher scores than aerobic packaged mutton kheema. However, there was no significant difference observed between CN & TN and also between CA&TA during all periods of storage (on 5th, 10th, 15th and 20th) under refrigeration except 0 day.

Juiciness

During the entire period of study all the samples of mutton kheema (CA, CN, TA and TN) were rated as Excellent to Very Good. In general, the highest scores were recorded for TN / TA on 0 day and lowest was recorded in CA on 20th day i.e. rated as very good for juiciness.

Mouth coating

Neither prune puree nor nitrogen flush package significantly (P>0.05) influenced the mouth coating scores of packaged mutton kheema during entire refrigerated storage and were rated as Very Good. No

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significant difference was observed between products on 0 and 5th day but significant difference was observed between CA and with all other products (CN, TA and TN) for 10th, 15th and 20th day.

Effect of incorporation of prune puree and packaging on the Sensory characteristics of Mutton Kheema under refrigerated storage (4±1°C) (Mean±SE)

PARAMETER	TREATMENT /GROUPS	STORAGE DAYS				
		0	5	10	15	20
Appearance	CA	8.11 ± 0.11^{aD}	7.80 ± 0.07^{aC}	7.58 ± 0.10^{aC}	6.91 ± 0.10^{aB}	6.41 ± 0.08^{aA}
	CN	8.11 ± 0.11^{aD}	7.89 ± 0.05^{aCD}	7.77 ± 0.08^{aC}	6.97 ± 0.09^{aB}	6.52 ± 0.08^{aA}
	TA	8.36 ± 0.09^{aE}	7.88 ± 0.05^{aD}	7.61 ± 0.09^{aC}	6.93 ± 0.05^{aB}	6.45 ± 0.05^{aA}
	TN	8.36 ± 0.09^{aE}	7.86 ± 0.06^{aD}	7.52 ± 0.10^{aC}	6.98 ± 0.07^{aB}	6.57 ± 0.06^{aA}
Flavour	CA	8.33 ± 0.11^{aD}	7.91 ± 0.10^{aC}	7.69 ± 0.10^{aC}	7.36 ± 0.13^{aB}	6.13 ± 0.13^{aA}
	CN	8.33 ± 0.11^{aB}	8.30 ± 0.07^{bB}	8.16 ± 0.09^{bAB}	8.13 ± 0.10^{bAB}	7.88 ± 0.08^{bA}
	TA	8.36 ± 0.10^{aD}	$8.00\pm.08^{aCD}$	7.80 ± 0.14^{aBC}	7.52 ± 0.15^{aAB}	6.56 ± 0.15^{aA}
	TN	8.36 ± 0.10^{aB}	8.33 ± 0.10^{bB}	8.13 ± 0.07^{bAB}	8.16 ± 0.07^{bAB}	7.80 ± 0.10^{bA}
Juciness	CA	8.02 ± 0.10^{C}	7.63 ± 0.11^{aB}	7.52 ± 0.11^{B}	7.33 ± 0.09^{aB}	7.00 ± 0.13^{aA}
	CN	8.02 ± 0.10^{B}	8.00 ± 0.11^{bB}	7.88 ± 0.11^{AB}	7.75 ± 0.10^{abAB}	7.63 ± 0.08^{bA}
	TA	8.05 ± 0.11^{C}	7.88 ± 0.13^{abBC}	7.69 ± 0.14^{AB}	7.55 ± 0.14^{abA}	7.41 ± 0.12^{bA}
	TN	8.05 ± 0.11^{B}	8.00 ± 0.10^{bB}	7.80 ± 0.11^{AB}	7.63 ± 0.10^{bAB}	7.58 ± 0.09^{bA}
Texture	CA	8.05 ± 0.09^{C}	7.47 ± 0.15^{B}	7.33 ± 0.08^{aB}	7.16 ± 0.09^{AB}	6.88 ± 0.11^{A}
	CN	8.05 ± 0.09^{C}	7.80 ± 0.07^{B}	7.63 ± 0.09^{abB}	7.27 ± 0.06^{A}	7.13 ± 0.08^{A}
	TA	8.25 ± 0.09^{D}	7.55 ± 0.13^{C}	7.47 ± 0.09^{abBC}	7.20 ± 0.08^{AB}	7.02 ± 0.10^{A}
	TN	8.25 ± 0.09^{C}	7.66 ± 0.08^{B}	7.52 ± 0.09^{bB}	7.23 ± 0.07^{A}	7.15 ± 0.09^{A}
Mouthcoating	CA	7.72 ± 0.12^{D}	7.50 ± 0.10^{CD}	7.27 ± 0.08^{aBC}	7.02 ± 0.08^{aAB}	6.83 ± 0.11^{aA}
	CN	7.72 ± 0.12^{BC}	7.86 ± 0.11^{C}	7.66 ± 0.11^{bBC}	7.47 ± 0.08^{bAB}	7.19 ± 0.07^{bA}
	TA	7.86 ± 0.13^{C}	7.75 ± 0.12^{BC}	7.61 ± 0.11^{bBC}	7.47 ± 0.11^{bAB}	7.25 ± 0.12^{bA}
	TN	7.86 ± 0.13^{B}	7.80 ± 0.12^{B}	7.77 ± 0.10^{bB}	7.52 ± 0.09^{bAB}	7.29 ± 0.09^{bA}
Overall acceptability	CA	7.72 ± 0.12^{D}	7.50 ± 0.10^{CD}	7.27 ± 0.08^{aBC}	7.02 ± 0.08^{aAB}	6.83 ± 0.11^{aA}
	CN	7.72 ± 0.12^{BC}	7.86 ± 0.11^{C}	7.66 ± 0.11^{bBC}	7.47 ± 0.08^{bAB}	7.19 ± 0.07^{bA}
	TA	7.86 ± 0.13^{C}	7.75 ± 0.12^{BC}	7.61 ± 0.11^{bBC}	7.47 ± 0.11^{bAB}	7.25 ± 0.12^{bA}
	TN	7.86 ± 0.13^{B}	7.80 ± 0.12^{B}	7.77 ± 0.10^{bB}	7.52 ± 0.09^{bAB}	7.29 ± 0.09^{bA}

Texture

A significant (P<0.05) decrease of texture scores were noticed as storage period progressed from 0 to 20 days. Neither prune puree incorporation nor nitrogen flush package significantly (P>0.05) influenced the texture scores of packaged mutton kheema during entire refrigerated storage period among CA, CN, TA and TN.

Overall acceptability

There was significant (P<0.05) decrease in overall acceptability scores, as the storage progressed from 0 to 20 days. Nitrogen flush packaged group (CN and TN) rated significantly (P<0.05) higher overall acceptability scores than aerobically packaged group (CA and TA).

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