SHELF - LIFE OF MARINATED RABBIT MEAT

By

G. JAYACHANDRA KAMATH

DISSERTATION

Submitted in partial fulfilment of the requirement for the diploma

Post Graduate Diploma in Meat Processing Technology

Faculty of Veterinary and Animal Sciences

Kerala Agricultural University

Department of Livestock Products Technology

(MEAT TECHNOLOGY UNIT)

COLLEGE OF VETERINARY AND ANIMAL SCIENCES

MANNUTHY, THRISSUR - 680651

KERALA

1997

DECLARATION

I hereby declare that this dissertation entitled "**SHELF-LIFE OF MARINATED RABBIT MEAT**" is a bonafide record of research work done by me during the course of research and that the dissertation has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

G. JAYACHANDRA KAMATH

Mannuthy
30/12/97

Dr. P. KUTTINARAYANAN
Associate Professor

Meat Technology Unit
College of Veterinary & Animals Sciences
Mannuthy, Thrissur

CERTIFICATE

Certified that this dissertation entitled "**SHELF-LIFE OF MARINATED RABBIT MEAT**" is a record of research work done independently by Sri. G. JAYACHANDRA KAMATH, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

Dr. P. KUTTINARAYANAN
Major Advisor

Mannuthy
30/12/97

CERTIFICATE

We, the undersigned members of the Advisory Committee of Sri. G. Jayachandra Kamath, a candidate for the Post Graduate Diploma in Meat Processing Technology, agree that the dissertation entitled "**SHELF-LIFE OF MARINATED RABBIT MEAT**" may be submitted by Sri. G. JAYACHANDRA KAMATH, in partial fulfilment of the requirement for the diploma.

30/12/98

Dr. P. KUTTINARAYANAN
(Major Advisor, Advisory Committee)
Associate Professor
Meat Technology Unit
College of Veterinary & Animal Sciences, Mannuthy

Dr. J. ABRAHAM
Professor & Head
Meat Technology Unit
College of Veterinary & Animal Sciences
(Member)

Dr. GEORGE T. OOMMEN
Associate Professor
Meat Technology Unit
College of Veterinary & Animal Sciences
(Member)

ACKNOWLEDGEMENTS

I wish to record my deep sense of gratitude and indebtedness to **Dr. P. Kuttinarayanan,** *Associate Professor, Meat Technology Unit, College of Veterinary and Animal Sciences, Mannuthy for his advice and guidance during the course of my work.*

I am grateful to **Dr. J. Abraham,** *Professor & Head, Meat Technology Unit, College of Veterinary and Animal Sciences, Mannuthy for his valuable help and suggestions as member of advisory board.*

I wish to thank **Dr. George T. Oommen,** *Associate Professor, Meat Technology Unit, who has given me valuable technical help during my course of work and* **Dr. M. Sunil,** *Assistant Professor, Meat Technology Unit, for valuable help.*

I am thankful to **Dr. Surendranathan,** *Head, Department of Physiology and* **Dr. C.V. George,** *Head, Department of Statistics, for providing facilities to conduct the research work and analysis of the data.*

My thanks due to **Dr. A. Rajan,** *Dean, College of Veterinary and Animal Sciences, Mannuthy for providing facilities for this study.*

I express my gratitude to Dr. P.P. Vava, Director, Animal Husbandry Department of Kerala for granting deputation to undergo the course.

I extend my sincere thanks to staff of Meat Technology Unit, College of Veterinary and Animal Sciences, Mannuthy for their valuable help and co-operation during my course work.

G. JAYACHANDRA KAMATH

Dedicated to

my

Parents & Family

CONTENTS

LIST OF TABLES

Introduction

INTRODUCTION

Meat is an important source of animal protein in human diet. According to Indian Council of Medical Research, a balanced diet for meat eating adult should include 30g of meat or fish per day (Sharma *et al.*, 1985). Percapita availability of meat in India is 1.5kg per annum. Hence the production has to be augmented to a minimum of 2 million metric tons per annum and by 2000 AD as our meat demand will be to the tune of 2.5 million metric tons.

Pressure on land is increasing due to rise in human population and their living nature, while production of large animals for meat is decreasing. To compensate the deficiency, farming system has to be changed from mega livestock (cattle, buffalo, pigs) to micro livestock (poultry, quail, rabbit) which requires less space for rearing.

Rabbit for meat purpose has the advantages of its high prolificacy, higher growth rate, ability to convert low quality vegetable waste into good quality meat and to adapt to diverse management systems.

Rabbit meat can be popularised because of its low fat and cholesterol content and is acceptable to all sections of the population irrespective of religion, caste, creed or sex.

Marginal farmers can rear them under backyard system in the premises of their residence in the similar lines as the backyard rearing system of poultry in order to meet their meat requirement.

Rabbit meat has high content of protein, but low level of Na, fat and cholesterol (Rao, *et al.*, 1978). The proximate analysis of rabbit meat reveals that it contains 60 to 70 per cent water, 19 to 21% protein, 8.5 to 16% fat and about 1% minerals. Rabbit meat is highly palatable with rich flavour.

The fast changing socio-economic conditions and living standards of consumers, necessitate development of convenience food (ready to eat). Perusal of the available literature reveals that not much work has been carried out on the marination of rabbit meat and its shelf-life at different periods of storage and temperature. Hence the present study is of practical and scientific utility in developing a ready-to-fry consumer food item from rabbit meat. It is also expected to provide better return for the farmer, because of value addition, better marketability and increased acceptability by the consumers.

Review of literature

REVIEW OF LITERATURE

Characteristic of rabbit meat

Solomon *et al.* (1981) while comparing proximate analysis of rabbit meat from light and heavy local albino rabbit reported that the light female had higher percentage of moisture content while heavy female had higher ether extract and ash content and light male had maximum protein content. A significant difference in dressing percentage of male and female American Chinchilla crossbred rabbits were reported by Joy, *et al.* (1985). Deltoro, *et al.* (1987) compared changes in the chemical composition of rabbit meat during growth of different muscles and found meat from hind leg and *M. longissimus lumbaris* had higher content of protein and lower content of fat than rest of the carcass.

Kuttinarayanan and Nandakumar (1989) compared the dressing percentage of Soviet chinchilla and Newzeland white rabbit and found 53.5% and 54.72%, respectively. Rabbit meat contained higher quantity of Palmitic, linolenic and myristic acids and low level of stearic acid small amount of short chain fatty acids. (Cambero, et al., 1991). Dzudie and Okubanjo (1992) compared two skinning and curing methods on the quality of rabbit meat and reported that skinning and curing methods significantly

affected the proximate composition and chloride content of aged meat, but had no effect on final pH. Brine injection significantly affected the salt content and tenderization of the rabbit meat. Dzudie and Tandem (1994) obtained better score rating for goat and rabbit sausage compared to beef sausage.

Kumar, *et al.* (1994) on analysis of broiler rabbit meat found that broiler rabbit of 8 weeks contained more unsaturated fatty acid, and poly unsaturated fatty acid than older rabbits of 12 weeks.

pH of rabbit meat

Oreskovich, *et al.* (1992) studied effect of marinade on pH and textural properties of beef and found that low and high muscle pH after marination had positive effect on texture and resulted in increased water binding capacity, moisture content and decreased cooking loses with rapid changes at low pH. Yang and Chen (1993) studied the effect of refrigerated storage on pH adjustment and marinade on colour of raw and microwave cooked chicken meat revealed that there was positive co-relation between raw and cooked chicken meat colour to pH and could be altered with marinade containing citric acid and sodium tripolyphosphate (STPP).

Storage and shelf-life of rabbit meat

Das, S.A. and Ramanathan (1990) found that dehydrated spiced rabbit meat mince had 6 months shelf-life at 28°C and 3 months shelf-life at 37°C, respectively. An increase in the concentration of acetic acid treatment (1 to 4%) resulted in increased bacteriostatic and bactericidal effect on buffalo meat stored at refrigerated temperature upto 7 days and the effect reduced with increasing storage period (Surve *et al.*, 1991). Japanese quail carcass dipped in STPP solution for 6 hrs and stored at different temperatures (4°C and -20°C) and period had positive influence on water and salt soluble protein fractions (Reddy *et al.*, 1992). There were intrinsic difference in protein degradation of white and red rabbit muscles during refrigerated and frozen storage (Nair and Amla, 1993). Rabbit cuts barbecued with 10% vinegar had significantly enhanced the cooking yield and sensory scores as observed by Keshri *et al.* (1994). Quail meat blended with 2% salt and 0.5% STPP maintained superior quality and could be stored under refrigeration for 8 days (Singh, *et al.*, 1994). Reddy *et al.* (1994) studied the effect of various chemical treatments on the quality of refrigerated cockrelmeat and found that 3% STPP resulted in high moisture intake reduced cooking lose and thiobarbituric acid number (TBA number). Panda, *et al.* (1995) reported that the treatment of quail meat with STPP raised muscle pH by 0.3 units, yield more tender product with retarded lipid

peroxidation during storage and the product remained acceptable throughout 4 weeks of storage under refrigeration. Sawaya *et al.* (1995) observed that the pretreatment of fresh chicken carcass with lactic acid buffer (10%) increased shelf-life to 13 days when stored at 4°C and 10 days at 7°C, while untreated carcasses could be stored for 6 to 7 days and 4 to 5 days, respectively. Ziauddin *et al.* (1995) conducted a study on the effect of lactic acid, ginger extract and sodium chloride on quality and shelf-life of refrigerated buffalo meat and found that all the treatments increased shelf-life. Meat cuts and chicken carcasses when sprayed with acetic acid or lactic acid and extract of ginger, garlic and onion singly or in combination with sodium chloride extended the shelf-life of meat at ambient temperature (Ziauddin, *et al.*, 1996).

Tyrosine value (T.V.) and Thiobarbituric acid (TBA)

Strange, *et al.* (1977) found tyrosine value (TV) to monitor effectively the meat quality in respect of proteolysis and to measure the amino acid, tyrosine and tryptophan present in a nonpolar extract of meat. Tyrosine value increased rapidly in meat stored for 5 days at 7°C than at -1°C. Strange and Benedict, (1978) reported a higher tyrosine value (TV) after 20 days of storage. The level in hot boned and conventionally chilled meat were approximately equal at the start but increased faster in hot boned than conventionally chilled samples. Tyrosine

value levels were affected by bacterial population in meat. Nathappan (1981) reported a tyrosine value of 25.27 µg/100g for fresh mutton and 28.23 µg/100g for 72 hrs refrigerated sample and noticed a highly significant correlation between identical characters like extract release volume (ERV) and TBA numbers.

Kandasami (1983) noticed a highly significant correlation between ERV and TV of fresh and stored meat and concluded that lower initial value predicted a longer shelf life. Lee, *et al.* (1986) observed that TBA number of a product was significantly reduced with the increase in the addition of ginger extract. TBARS value for rabbit burgers wrapped in poly ethylene film increased continuously during storage at 4°C (Fernandez, *et al.*, 1993).

Bacteriological qualities

Sofos (1985) observed that, on storage at ⁻20°C the microbial growth and comminuted meat product spoilage were more rapid with decrease brine level irrespective of the presence or absence of STPP. Anand *et al.* (1989) found that gradual reduction in microbial count during frozen storage of dressed chicken at ⁻18°C, and the chicken carcasses were found acceptable even after six months. Surface sanitization using 3% acetic acid or 2% sodium chloride or 3% acetic acid or 3% sodium ascorbate effectively reduced microbial count in vacuum packed fresh

pork chops during storage at 2-4°C for 4 weeks and effectively inhibited the growth of enterobacteriacea (Mendonca, *et al.*, 1989).

Frederick, *et al.* (1994) reported that a significant reduction in the incidence of *Salmonella* typhimuram, aerobic plate count and coliform count could be attained by applying 2% acetic acid.

Organoleptic evaluation

Malik *et al.* (1990) found that rabbit meat patties with 5% hydrogenated vegetable fat (HVF) were superior to patties with 10% and 15% HVF and control in sensory evaluation proximate composition and cooking yield. Ziauddin, *et al.* (1993) obtained in consistent values for TV and TBA during storage with a significant difference in organoleptic properties. Schonfeldt *et al.* (1993) found that the meat of younger animal is more tender contain less fibrous tissue residue and the species flavour is less typical than that of older animals. With increasing fatness of carcasses, the tenderness and flavour of the cooked cut increased significantly.

Materials and methods

MATERIALS AND METHODS

Six Newzeland white crossbred rabbits of one year age were collected from The Small Animal Breeding Station, Mannuthy. Rabbits were scientifically and hygienically slaughtered and dressed at the meat technology unit, the Department of Livestock Products Technology, College of Veterinary and Animal Sciences, Mannuthy. The dressed carcasses were weighed and cut up into suitable sizes for the study. pH of the fresh meat was recorded using digital pH meter. (Elico-127). Cut up parts were divided into 4 groups for marination studies.

Three different marinades using either curd (group-2), lime (group-3) or vinegar (group-4), besides common ingredients such as pepper, cardamom, chilli, cinnamon, anisi, clove, garlic, ginger, turmeric, salt were prepared. The composition of which are given in Appendix. The control (Group-1) contain only salt.

The marinade mixes were applied to the respective groups of cut up meat and kept for 3 hours at room temperature. pH of the marinated meat was recorded after 3 hours of marination. Prepared samples were packed in high density-polyethylene films and stored at -6°C (Household refrigerator freezer) and -20°C for upto 30th day. The samples were analysed for tyrosine value,

thiobarbituric acid number, aerobic plate count, and organoleptic quality of the product on zero (3 hours after marination) 5th, 15th and 30th day of storage.

Studies on total of six batches were conducted for assessing the repeatability of results.

(a) pH

pH was measured as per method described by Dransfield, *et al.* (1983). One gram meat sample was homogenised in 10ml, 5mm sodiumiodoacetate and the pH of the slurry was measured with the help of digital pH meter (Elico-127).

(b) Tyrosine value (TV)

Tyrosin value estimated as per the method of wood, sigurdssan and Dyel and described by Pearson (1968) with modification by strange *et al.* (1977).

Two grams of meat sample was blended in 5ml of cooled 20% trichloro acetic acid (TCA) for 2mts using mechanical blender. The homogenate was transferred quantitatively into a measuring jar and made up the volume 10ml with distilled water, and mixed thoroughly by shaking. It was then filtered through Whatman filter paper No.1 (TCA extract).

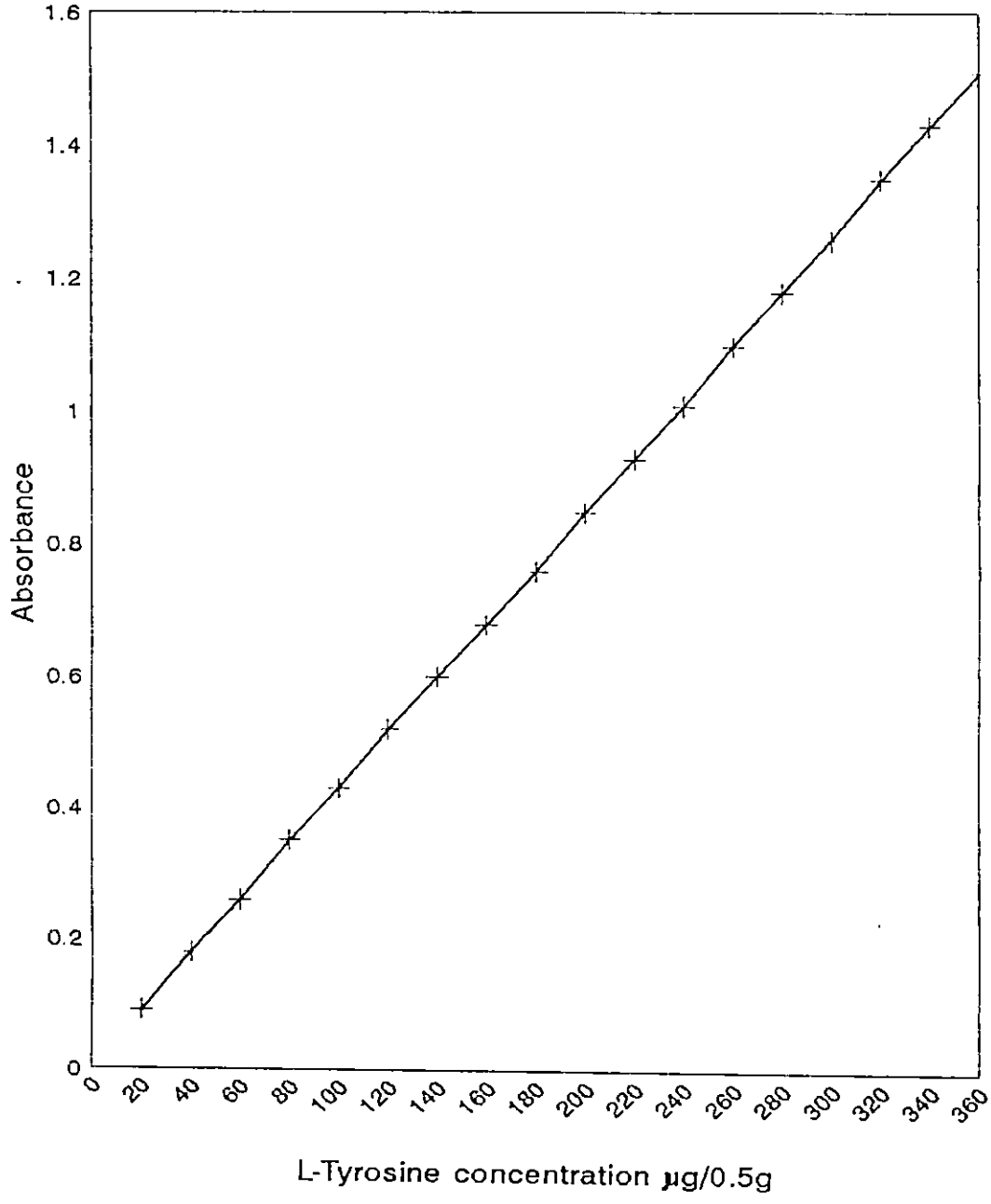
To 0.5ml of TCA extract equal quantity of distilled water was added in a test tube. 2ml sodium hydroxide was added to the above, followed by 0.6ml of diluted, folin-ciocalteu phenol reagent (I volume of concentrated reagent and 2 volume of distilled water). After mixing the contents were allowed to stand 15 min. at room temperature. The developed colour was measured as absorbence at 660nm in systronics 119 uv-vis spectrophotometer, after reference on blank prepared. By reference to a standard graph prepared Tyrosine value was calculated and expressed as Mg tyrosine per 100g of samples (Fig.1).

(c) Thiobarbituric acid number (TBA number)

Thiobarbituric acid number was measured as per method described by Witte *et al.* (1970).

Two gram of meat was blended with 5ml of TCA (20% TCA in 2M orthophosphoric acid) and 2.5ml of the extract was transferred to a screw capped test tube followed by 2.5ml of 0.005M Thiobarbituric acid reagent. The tube was stoppered and the contents were mixed by inversion and kept in a dark place overnight (12-15 hrs) at room temperature. The resulting colour was measured at 530 nm in systronic - 119 Uv-vis spectrophotometer as optical density with reference to a blank. The TBA number was calculated by multiplying the absorbance by `K' value (5.2) and expressed as milligram malonaldehyde per kg meat (Witte *et al.*, 1970).

Fig.1 Standard graph for estimation of Tyrosine value



(d) Aerobic plate count (Mesophilic and Psychrophilic)

Bacteriological count of the samples were done as per the standard method prescribed in Bureau of Indian Standards IS-1479. Meat samples were taken aseptically and weighed and blend. Serial dilution were prepared in phosphate buffer solution (pH 7.2).

One ml each of the inoculum was transferred to petridishes in duplicate and added 10-12 ml sterile standard plate count agar (SPCA) melted and cooled at 42°C, mixed by rotary movements and allowed to solidify. The petridishes were incubated at 37°C for 48 hrs. Bacterial count was taken for the plates having colonies between 30 to 300 in duplicate plate and average was found out.

Psychrophilic count was determined after the incubation of the inoculated petridish at 5°C for 7 days.

(e) Organoleptic evaluation

Sensory evaluation of the deep fat fried product was carried out by 5 semitrained panelist using a 9 point hedonic scale (Score card appended).

(f) Economics of products

Economics of marinated rabbit meat was calculated based on actual costing of the ingredients.

(g) Statistical analysis

Data were analysed as per method outlined by Snedecor and Cochran (1968).

Results

RESULTS

Six Newzeland White Crossbred rabbit carcasses were cut into suitable size and marinated with 3 different marinades containing either curd, lime or vinegar, besides a control marinade of salt alone. Observations on pH of marinade, pH of marinated rabbit meat cuts, Tyrosine valve, TBA number, aerobic plate count and sensory evaluation at different periods of storage at -6°C and -20°C were noted. Cost of the product was also calculated.

I pH

The three different marinade mixes were prepared with common ingredients, viz., pepper, cinnamon, anise, clove, garlic, chilly, salt and with either curd, lime or vinegar. The control marinade contained only salt. The pH of marinade mixes was recorded (Table 1). It was found that the mix containing lime had the lowest mean pH value of 4.97±0.21 and that of the mix containing curd had the highest value. The values were not significantly different among the groups.

The rabbits were slaughtered and dressed and cut into suitable size and divided into four groups. Different marinade mixes were applied to the respective group and allowed to stand at room temperature (30°C-32°C) for three hours.

Table 1 Mean pH of marinade and marinated Rabbit Meat

Treatment	pH of marinade mix	pH of marinated meat
Group I	No marinade	6.327 ± 0.10
Group II	5.407 ± 0.21	5.753 ± 0.10
Group III	4.967 ± 0.21	5.437 ± 0.10
Group IV	5.267 ± 0.21	5.838 ± 0.10

The pH of the marinated rabbit meat was recorded three hours after marination (Table 1). It was observed that the lowest mean pH was recorded in Group III samples which contained lime juice marinade. The highest pH value of 6.33±0.10 was recorded in Group I, which did not contain any of the spices and seasonings. Analysis of variance showed that the pH of control sample (Group I) had significantly higher pH than those of the marinated meat sample.

II Tyrosine value

The tyrosine value of the samples analysed is expressed in terms of mg of tyrosine per 100 g of sample and presented in Table 2.

It was observed that the control sample on the initial day recorded lowest content of tyrosine 72 mg while Group IV which contained marinade with vinegar recorded 114.33 mg of tyrosine. It was observed that a very slight increase of tyrosine value from 182.833 to 184.02 occurred in the group stored at -6°C. At -20°C storage, the group means were 117.25, 153.5 and 143.458 at 5th, 15th and 30th day of the storage respectively.

In general 15th day storage had higher content of tyrosine value compared to 30th day of storage both at -6°C and -20°C storage temperature. The group mean varied

Table 2 Mean Tyrosine value of marrinated Rabbit Meat at different storage periods - mg/100g

Treatment	0 day	5th day		15th day		30th day		Mean ± Standard Error
		-6°C	-20°C	-6°C	-20°C	-6°C	-20°C	
Group I	72.00	172.333	100.000	178.167	149.667	190.500	162.833	146.500 ± 9.425
Group II	84.667	147.833	121.000	225.000	182.333	196.000	132.667	155.643 ± 10.233
Group III	82.667	190.833	122.333	163.000	125.667	176.667	141.333	143.214 ± 10.101
Group IV	114.333	220.330	125.667	162.667	156.333	173.000	137.000	155.619 ± 10.402
Mean ± Standard Error	88.417 ± 8.482	182.833 ± 16.499	117.250 ± 8.723	182.21 ± 11.153	153.50 ± 13.241	184.042 ± 11.787	143.458 ± 8.297	

from 143.214 (Group III) to 155.643 (Group II). The Group II and IV recorded almost similar values.

It was observed that the treatments were not significantly different in respect of content of tyrosine while the storage period showed significant effect on tyrosine value of different groups of marinated rabbit meat.

III TBA number

The mean and standard error of the thiobarbituric acid numbers expressed interms of mg of malonaldehyde is presented in Table 3.

It was observed that the mean for zero day sample had the lowest value of 0.172±0.027 and Group II sample had the lowest among group means 0.211±0.28.

Among storage temperature it was found that -6°C recorded a higher mean than that of -20°C throughout the storage. Group III samples had higher TBA of 0.242±0.029. Similarly at storage temperature of -6°C, the samples stored till 30th day recorded a highest mean value of 0.283±0.040.

The analysis of the data showed that the treatment had no significant effect on TBA number, while storage period had significant effect on TBA content.

Table 3 Mean TBA values of marrinated Rabbit Meat at different storage periods

Treatment	0 day	5th day		15th day		30th day		Mean ± Standard Error
		-6°C	-20°C	-6°C	-20°C	-6°C	-20°C	
Group I	0.128	0.367	0.107	0.266	0.164	0.314	0.190	0.220 ± 0.030
Group II	0.139	0.193	0.188	0.339	0.213	0.247	0.158	0.211 ± 0.028
Group III	0.198	0.218	0.259	0.235	0.309	0.275	0.205	0.242 ± 0.029
Group IV	0.222	0.224	0.174	0.239	0.165	0.295	0.224	0.221 ± 0.024
Mean ± Standard Error	0.172 ± 0.027	0.251 ± 0.035	0.182 ± 0.036	0.270 ± 0.045	0.213 ± 0.033	0.283 ± 0.040	0.194 ± 0.037	

IV Aerobic plate count

The colony forming unit of the aerobic bacteria was expressed in terms of Log count $x10^4$ and shown in Table 4.

Initially the microbial count of the sample was 2.423. It was observed that the count had an upward trend at 5th day, 15th day and 30th day at -6°C.

In case of -20°C storage, the count was increased on 5th and 15th day and reduced below the initial day count by 30th day. Among groups, the Group III had the highest count 2.607. CFG and others were ranging from 2.53 to 2.583.

It was observed that different treatments had no significant effect on the microbial count whereas storage period had significant effect on microbial count of rabbit meat.

V Sensory evaluation

Four groups of meat samples were deep fat fried separately and sensory evaluation was carried out by semi trained taste panelists with the help of a `9' point hedonic scale - score card.

(a) Colour

The sensory evaluation score of colour is shown in Table 5. It was observed that Group I sample showed the

Table 4 Mean (Log count x 10^4) Aerobic Plant Count

Treatment	0 day	5th day		15th day		30th day		Mean ± Standard Error
		-6°C	-20°C	-6°C	-20°C	-6°C	-20°C	
Group I	2.452	2.742	2.527	2.820	2.311	2.974	2.258	2.583 ± 130.075
Group II	2.423	3.092	2.485	2.918	2.682	2.217	2.098	2.559 ± 169.596
Group III	2.351	3.096	2.889	2.635	2.428	2.427	2.426	2.607 ± 144.145
Group IV	2.467	2.466	3.050	2.877	2.252	2.151	2.446	2.530 ± 141.470
Mean ± Standard Error	2.423 ± 134.465	2.849 ± 219.729	2.738 ± 205.877	2.813 ± 187.307	2.418 ± 208.824	2.442 ± 198.655	2.307 ± 171.886	

Table 5 Mean score in sensory evaluation for colour of marrinated Rabbit meat at different storage periods

Treatment	0 day	5th day		15th day		30th day		Mean ± Standard Error
		-6°C	-20°C	-6°C	-20°C	-6°C	-20°C	
Group I	3.667	3.725	3.675	3.567	3.608	3.858	4.067	3.738 ± 0.102
Group II	6.133	5.897	5.783	6.167	6.267	6.817	6.825	6.270 ± 0.101
Group III	5.877	6.350	6.633	6.483	6.358	6.625	7.208	6.505 ± 0.102
Group IV	6.250	6.308	6.367	6.300	6.308	7.033	7.317	6.555 ± 0.090
Mean ± Standard Error	5.482 ± 0.236	5.570 ± 0.247	5.615 ± 0.261	5.629 ± 0.277	5.635 ± 0.258	6.083 ± 0.313	6.354 ± 0.300	

lowest value of 3.738±0.102 whereas the Group IV samples showed the highest value of 6.555±0.090.

The initial day score was lower than that of longer storage periods. As storage period increased the score also increased and the storage period had significant effect on the colour of the product. Similarly the marinade had significant effect on colour score whereas temperature of storage did not show any significant effect.

(b) Flavour

The mean flavour score of the marinated rabbit meat is shown in Table 6.

It was observed that the control sample had a lower score throughout the study and the marinated groups had comparatively higher scores throughout the study. The initial group mean of Group I was 3.756±0.127 whereas that of Group II was the highest 6.519±0.116. On the initial day, the control sample recorded a score of 4.508 and showed a decrease in different phases/different storage periods.

In general the 30th day of storage irrespective of temperature showed higher scores than that of initial day in all the other three groups. It was observed that the different treatment and storage period had significant effect on the flavour scores of marinated rabbit meat.

Table 6 Mean scores in sensory evaluation for flavour of marrinated Rabbit meat at different storage periods

Treatment	0 day	5th day		15th day		30th day		Mean ± Standard Error
		-6°C	-20°C	-6°C	-20°C	-6°C	-20°C	
Group I	4.508	3.833	3.883	3.267	3.117	3.783	3.902	3.756 ± 0.127
Group II	6.467	6.605	6.192	6.133	6.392	6.867	6.975	6.519 ± 0.116
Group III	6.583	5.817	5.750	6.217	6.417	6.642	7.133	6.365 ± 0.108
Group IV	6.250	5.942	5.997	6.300	6.083	7.175	7.525	6.467 ± 0.159
Mean ± Standard Error	5.952 ± 0.222	5.549 ± 0.264	5.455 ± 0.252	5.479 ± 0.309	5.502 ± 0.318	6.117 ± 0.320	6.384 ± 0.325	

(c) Juiciness

The juiciness scores of the marinated rabbit meat is presented in Table 7.

Group I sample revealed a lower score of 3.374±0.131 and a high mean of 6.399±0.163 in the case of Group IV samples. Group I samples on day zero revealed, a higher score than throughout the storage period, whereas the scores in the other groups has shown an opposite trend. Except in the case of Group I sample. all the other 3 groups recorded a higher rating on 30th day when compared to zero day scores.

It was observed that the group and storage period had significant effect on the juiciness score and the maximum score of 7.067 was obtained by vinegar treated samples on 30th day at -20°C, and followed by 6.958 at -6°C. It was observed that the different treatments and storage period had a significant effect on juiciness of marinated rabbit meat.

(d) Tenderness

The score obtained for the tenderness of cooked rabbit meat is shown in the Table 8.

Table 7 Mean scores in sensory evaluation for juiciness of marrinated Rabbit meat at different storage periods

Treatment	0 day	5th day		15th day		30th day		Mean ± Standard Error
		-6°C	-20°C	-6°C	-20°C	-6°C	-20°C	
Group I	4.083	3.400	3.283	2.750	2.867	3.625	3.608	3.374 ± 0.131
Group II	5.842	5.833	5.392	5.433	6.058	6.108	6.242	5.844 ± 0.128
Group III	5.917	6.017	5.900	5.550	6.142	5.950	6.575	6.007 ± 0.128
Group IV	6.142	6.192	6.017	6.117	6.300	6.958	7.067	6.399 ± 0.163
Mean ± Standard Error	5.496 ± 0.256	5.360 ± 0.293	5.148 ± 0.287	4.963 ± 0.323	5.342 ± 0.342	5.660 ± 0.311	5.873 ± 0.306	

Table 8 Mean scores in sensory evaluation for tenderness of marinated Rabbit meat at different storage periods

Treatment	0 day	5th day		15th day		30th day		Mean ± Standard Error
		-6°C	-20°C	-6°C	-20°C	-6°C	-20°C	
Group I	3.767	3.975	3.658	3.067	3.100	4.008	3.658	3.605 ± 0.134
Group II	5.943	6.383	5.975	6.317	6.317	6.417	6.600	6.279 ± 0.125
Group III	5.808	6.575	6.100	6.000	6.392	5.983	7.142	6.286 ± 0.140
Group IV	6.500	6.750	6.508	6.550	6.683	7.367	7.450	6.830 ± 0.134
Mean ± Standard Error	5.505 ± 0.285	5.921 ± 0.291	5.560 ± 0.284	5.483 ± 0.328	5.623 ± 0.338	5.944 ± 0.320	6.213 ± 0.337	

It was noticed that rabbit meat without any marinade recorded lower rating than marinated samples throughout the study with a group mean of 3.605±0.134.

Among treatments, Group IV rated the highest of 6.83±0.134. The control rabbit meat had the lowest rating of 3.1 on 15th day whereas the score was 7.45 in the case of marinated vinegar treated samples at -20°C on 30th day of storage.

The storage period of marinated meat had significant effect on tender score and the treatments had a highly significant effect as evidenced by the mean ranging from 3.605 to 6.83.

(e) Overall acceptability

The overall acceptability score of the samples are shown in Table 9.

It was noticed that the control sample (Group I) had a lower score than that of treated samples through out the study as evidenced by group mean of 3.569±0.086.

Control sample on day zero recorded a higher rating whereas for treated samples, the score increased during storage period.

Table 9 Mean scores in sensory evaluation for overall acceptability of marinated Rabbit meat at different storage periods

Treatment	0 day	5th day		15th day		30th day		Mean ± Standard Error
		-6°C	-20°C	-6°C	-20°C	-6°C	-20°C	
Group I	4.050	3.275	3.417	3.333	3.375	3.925	3.608	3.569 ± 0.086
Group II	5.993	5.908	5.833	6.342	6.467	6.825	6.742	6.301 ± 0.110
Group III	5.980	6.035	6.125	6.000	6.317	6.633	7.233	6.332 ± 0.107
Group IV	6.285	6.508	6.100	6.455	6.833	7.358	7.785	6.761 ± 0.126
Mean ± Standard Error	5.577 ± 0.208	5.432 ± 0.286	5.369 ± 0.254	5.532 ± 0.285	5.748 ± 0.302	6.185 ± 0.324	6.342 ± 0.361	

The group mean of the treated samples under storage temperature of -20°C varied from 5.369±0.254 to 6.342±0.361. The highest scores was 7.785 for Group IV at -20°C and it was noticed that the score of the sample at 0 day was 6.285.

The treatment and storage period had significant effect on overall acceptability of marinated rabbit meat whereas storage temperature did not show any significant effect on the overall acceptability.

VI Cost structure of marinated rabbit meat

The cost structure of marinated rabbit meat was calculated based on the prevailing market rate of rabbit meat and other ingredients and it was found that the total expenses per 100g was Rs.5.35, Rs.5.76, Rs.5.97 and Rs.5.8 (Table 10) for Groups I, II, III and IV respectively.

The higher cost for Group III was due to cost of lime infact.

Table 10 Cost structure of marinated Rabbit meat

	Group I (Control)	Group II (Curd)	Group III (Lime juice)	Group IV (5% vinegar)
Cost of 100 g rabbit meat	4.50	4.50	4.50	4.50
Cost of spices, seasonings, STPP etc.	0.05	0.37	0.37	0.37
Cost of special ingredients	-	0.09	0.30	0.13
Processing charge including packing freezing	0.80	0.80	0.80	0.80
Total expenses	5.35	5.76	5.97	5.80

Discussion

DISCUSSION

Rabbit meat cuts were marinated with three different marinades containing either curd, lime or vinegar besides a control of salt alone. The effect of these marinades on microbial, sensory and keeping qualities of rabbit meat cuts at different periods of refrigerated storage was studied.

pH

The pH of the marinade and marinated meat was lowest in Group III containing lime juice. This may be due to the presence of citric acid in lime juice and its effective penetration into rabbit meat cuts. Among the marinade mixes the curd mix had the highest pH, followed by the marinade containing vinegar. The rabbit meat marinated with vinegar had highest pH where as the meat marinated with curd had a lower pH. Oreskovich *et al.* (1992) reported that low and high muscle pH after marination had positive effect on the quality attributes of beef. In the present study, the marinated meat in group III (lime juice) obtained a significantly lower pH. According to *Oreskovich* lower pH would bring rapid changes in the textural properties of meat.

Tyrosine value and TBA number

Marination had no significant effect on Tyrosine value or TBA number of rabbit meat. In both the cases the zero day samples revealed the lowest content. On storage, value rose above the initial values. In this present study also the storage had a significant effect on tyrosine value and TBA, beyond 5 days of storage. Strange and Benedict (1978) reported a higher Tyrosine value after 20 days of storage. In general, the tyrosine value of rabbit meat at zero day was higher than the values reported by Rabindranath (1982), Ramamurth (1985) for mutton and Kandaswami (1983) for buffalo beef. The data obtained for marinated meat in respect of tyrosine value and TBA number are in agreement with those obtained by Ziauddin (1993) who reported a in constant value for buffalo meat frozen by plate and blast freezing.

Aerobic plate count

The present study reveals that the treatment had no significant effect on the microbial load whereas storage periods have significant effect. Though there is slight increase in the aerobic plate count on 5th and 15th day when compared with zero day, it is found to be insignificant. The aerobic bacterial count reduced substantially as the refrigerated storage prolonged beyond 15th day. Anand *et al.* (1989) also reported a decrease in microbial population as storage period enhanced. Ziauddin *et al.* (1996) advocated spraying of chicken carcasses with

acetic acid and lactic acid for the enhancement of shelf life. But in the present study, it was observed that organic acids in the marinades such as vinegar, lime juice, and curd had no significant effect on the aerobic bacterial load of marinated rabbit meat.

Organoleptic evaluation

The organoleptic qualities of the control and marinated rabbit meat revealed, that the marinades and storage period had highly significant effect on sensory qualities like colour flavour, juiciness tenderness and overall acceptability. But the storage temperature had little effect. It was also revealed that storage at -20°C till 30th day recorded the highest score for organoleptic qualities. Ziauddin *et al.* (1993) reported that frozen meat had higher score for texture, juiciness, aroma and overall acceptability on taste panel evaluation. It was also observed in the study that the storage had positive effect on taste panel results. These favourable changes may be due to the freezing of marinated meat which brings about certain physical and chemical changes besides action of the marinades.

Cost of products

The difference in the cost of the marinated rabbit meat was due to the variation in the price of ingredients like curd, lime and vinegar.

In this study, it is also observed that a high quality ready to fry marinated rabbit meat can be prepared from rabbit and can be stored both at -6°C and -20°C without any deterioration in quality upto 30 days.

Summary

SUMMARY

A study was conducted to assess the effects of three different marinades containing either curd, lime or vinegar on rabbit meat qualities in comparison to a control group. The study included various parameters viz., pH, tyrosine value, TBA number, aerobic plate count and sensory evaluation.

The results of the study revealed that the marination irrespective of the ingredients used had a significant effect on lowering the pH of the rabbit meat in comparison to the control.

The result on tyrosine value of marinated rabbit meat samples revealed that none of the treatments brought about protein degradation in the samples as evidenced by insignificant differences in the values. However, it was revealed that the tyrosine values increased substantially on storage of the samples including control at -6°C and -20°C over a period of 30 days. It was recorded higher tyrosine value at -6°C than -20°C throughout the study.

The TBA number also showed significant increase in all the samples as the storage period prolonged. Among groups, Group I had the lowest TBA values both at -6°C and -20°C, though all the groups showed an increasing trend in TBA value as the storage period increased. The treatment as

such did not show any significant effect on the TBA values of the meat samples. The samples stored at -6°C showed higher TBA values throughout the period of study.

The initial day log count of aerobic bacteria was 2.432×10^4. It was noticed that the counts showed an upward trend as storage period increased at -6°C. The mean bacterial count was reduced at -20°C by 30th day of storage. The treatment had no significant effect on aerobic count of the rabbit meat.

The sensory evaluation of 4 groups of rabbit meat was done with the help of `9' point hedonic scale - score card after deep fat frying.

The organoleptic evaluation of control and marinated rabbit meat revealed that the marinade and storage period had a highly significant effect on colour, flavour, juiciness, tenderness and overall acceptability. The highest score was observed for the marinated rabbit meat containing vinegar and stored at -20°C on 30th day.

The cost of marinated meat containing lime was highest due to higher price of the lime. In this study, it revealed that by marination, rabbit meat can be stored well at -6°C and -20°C without any deterioration in qualities upto 30 days.

References

REFERENCES

Anand, S.K., Pandey, N.K., Mahapatra, C.M. and Varma, S.S. (1989). Effect of storage on microbial quality of dressed chicken held at -18°C. *J. Food Sci. and Technol.* 26(5): 296-297

Anthonydas, S. and Ramanathan, L.A. (1990). Dehydrated Spiced Rabbit Meat Mince. *Indian Food Packer* 44(4): 33-36

Anand, S.K., Pandey, N.K. and Varma, S.S. (1994). Effect of sodium hypophosphate and some organic acid on the microbial contaminants of dressed chicken. *Indian J. Poult. Sci.* 29(1): 110

Anand, S.K., Pandey, N.K., Verma, S.S. and Ramgopal (1995). Role of sodium hypophosphate in unhibiting the microflora of minced chicken meat. *Indian J. Poult. Sci.* 30(3): 268-270

Cambero, M.I., Hoz, L.D., Sanz, B. and Ordonez, J.A. (1991). Lipid and fatty acid composition of rabbit meat, Part I Apolar fraction. *Meat Sci.* 29: 153-166

Dransfield, E., Casey, J.C., Boccard, R., Touraille, C., Buchter, L., Hood, D.E., Joseph, R.L., Schon, I., Casteels, M., Cosenlino, E. and Tinbergen, B.J. (1983). *Meat Sci.* 8: 79

Deltoro, J. and Lopez, A.M. (1987). Changes in the chemical composition of rabbit meat during growth. *Meat Sci.* 19: 15-25

Dzudie, T. and Okubanjo, A. (1992). Effect of 2 skinning and curing method on the quality of rabbit meat. *J. Food Sci. and Technol.* 29(3): 162-166

Dzudie, T. and Tandem, C. (1994). Comparative study on goat, beef and rabbit sausage. *J. Food Sci. and Technol.* 31(4): 333-334

Dawood, A.A. (1995). Physical and Sensory Characteristics of Najadi - Camel meat. *Meat Sci.* 39: 59-69

Fernandez, Espala, M.D. and Oriell, E. (1993). Lipid oxidation in rabbit meat under different storage condition. *J. Food Sci.* 58(6): 1262-1264

Frederick, T.L., Miller, M.F., Thompson, L.D. and Ramsey, C.B. (1994). Microbiological properties of pork cheek meat as affected by acetic acid and temperature. *J. Food Sci.* 59(2): 300-302

Indian Standard Institute - Method of Test for Dairy Industry - Part III. Bacteriological Analysis of Milk (162). IS-1479. pp.8-16, 20 & 21

Joy, A.D., Jose, M.T. and Prabhakaran, P. (1985). Carcass characteristics of American Chinchilla Crossbred Rabbit. *Kerala J. Vet. Sci.* 16(2): 29-32

Kanda Sami, s. (1983). A study of certain physico-chemical characteristic and odour score in fresh and stored carabeef. M.V.Sc. thesis submitted to Tamil Nadu Agricultural University, Coimbatore

Kuttinarayanan, P. and Nandakumar, P. (1989). Carcass yield and characteristics of Broiler Rabbit. *Kerala J. Vet. Sci.* 20(2): 84-87

Kumar, V. and Bachhil, V.N. (1993). Studies on the development of Pork Pickle - Effect of different preservatives on its quality and shelf life. *Indian Food Packer* 47(1): 15-21

Kumar, S., Raina, P.L., Nair, R.B. and Amla, B.L. (1994). Lipid profile and fatty acid composition of Broiler Rabbit meat. *J. Food Sci. and Technol.* 31(3): 255-258

Keshri, R.C., Kumar, S. and Bachhil, N.N. (1994). Quality characteristics of Barbecued Rabbit Cuts. *Beverages and Food World* 21(1): 36-37

Lee, Y.B., Kim, Y.S. and Ashmore, C.R. (1986). Antioxidant property in ginger rhizome and its application to meat products. *J. Food Sci.* 51(1): 20-23

Malik, A.H., Keshri, R.C. and Sharma, N. (1990). Effects of different levels of hydrogerated vegetable fat in sensory, proximate and cooking quality of rabbit meat pattis. *Indian J. Meat Sci. & Technol.* 3(1): 10-17

Mendonca, A.F., Molins, R.A., Kraft, A.A. and Walker, H.W. (1989). Microbiological, chemical and physical changes in Fresh vaccum packed pork treated with organic acids and salts. *J. Food Sci.* 54(1): 18-21

Nathappan, M. (1981). A study of certain physico-chemical changes in stored mutton in relation to odour score. M.V.Sc. thesis submitted to Tamil Nadu Agricultural University, Coimbatore

Nair, K.S. and Amla, R.B. (1993). Effect of postmortem chill and frozen storage on protein degradation of broiler rabbit muscles - Analysis by SDS gel electrophoresis. *Indian J. Anim. Sci.* 63(10):1042-1049

Oreskovich, D.C., Bechtel, P.J., McKeith, F.K., Novakofski and Basgall, E.J. (1992). Marinade pH affects textural properties of beef. *J. Food Sci.*57(2):305-311

Pearson, D. (1968). Application of chemical methods for the assessment of (i) beef quality, (ii) methods related to protein breakdown. *J.Sci.Food Agric.*19: 366

Panda, S.K., Singh, R.P. and Anand, S.K. (1995). Effect of polyphosphate chilling and packaging on the quality of fried quail stored in refrigeration. *J. Food Sci. and Technol.* 32(2): 156-158

Rao, D.R., Sunki, G.R., Johnson, W.M. and Chen, C.P. (1978). Effect of weaning and slaughter ages of rabbit meat production II. Carcass quality and composition. *J. Anim. Sci.* 46(3): 578-583

Rabindranath, V. (1982). Studies on the pH, tyrosin value and water holding capacity of mutton held at dry ice and water ice. M.V.Sc. thesis submitted to Tamil Nadu Agricultural University, Coimbatore

Ramamurthi, R. (1985). A study on the meat qualities of chicken and lamb. Ph.D. thesis submitted to Tamil Nadu Agricultural University, Coimbatore

Reddy, K.P., Narahari, D., Jayaprasad, A. (1992). Influence of STPP treatment on fractionation of Japanese quail muscle protein. *J. Food Sci. and Technol.* 29(1): 60-61

Reddy, K.P. and Reddy, V.R. (1994). quality of refrigerated cockrel meat as influenced by chemical treatments. *Indian J. Anim. Sci.* 64(1): 71-74

Snedecor, G.W. and Cochran, W.G. (1968). Statistical methods. 6th edn. Oxford and IBH Publishing Co., Calcutta

Strange, E.D., Benedict, R.C., Smith, J.C. and Swift, C.E. (1977). Evaluation of rapid test for monitoring alteration in meat quality on storage. *J. Food Protection* 40: 843

Strange, E.D. and Benedict, R.C. (1978). Effect of postmortem boning times on beef storage quality. *J. Food Sci.* 43: 1652

Solamon, D.F., Ramamurthi, R., Govindarajan, C.V. and Shanmughanathan (1981). Meat, bone and fat content in rabbit carcasses and proximate composition of rabbit meat. *Cherion* 10(3): 111-116

Sofos, J.N. (1985). Influence of sodium tripolyphosphate (STPP) on the binding and antimicrobial properties of reduced Nacl, comminuted meat product. *J. Food Sci.* 50(50: 1379-1383

Sharma, T.R., Ramanath and Vasundhara (1985). Meat Industry in India - an over view. *Indian Food Packer.* 39(6): 24-28

Surve, A.N., Sherikar, Bhilegaonkar, K.N. and Karkare, N.D. (1991). Preservative effect of combination of acetic acid with/lactic acid or propionic acid on buffalo meat stored at refrigerated temperature. *Meat Sci.* 29(4): 309-322

Schonfeldt, H.C., Naude, R.T., Bok, W., Van. Heerden, S.M. and Smit, R.C. (1993). Flavour and Tenderness - Related quality characteristics of goat and sheep meat. *Meat Sci.* 34: 363-379

Singh, R.P., Anand, S.K. and Verma, S.S. (1994). Quality of salt and polyphosphate preblended hot deboned quail meat during refrigerated storage. *Indian J. Poult. Sci.* 29(2): 163-169

Sawaya, W.N., Elnawavy, A.S., Al-zenki, S., Al-lotaibi, J., Al-omirah, H. and Amiri, A. (1995). Storage stability of chicken as affected by MAP and lactic acid treatment. *J. Food Sci.* 60(3): 611-614

Witte, V.C., Krause, G.F. and Bailey, M.E. (1970). A new extraction method for determining 2 thiobarbituric acid values of pork and beef during storage. *J. Food Sci.* 35: 582-585

Yang, C.C. and Chen, T.C. (1993). Effect of refrigerated storage, pH adjustment and marinade on colour of raw and micro wave cooked chicken meat. *Poult. Sci.* 72(1): 355-366

Ziauddin, K.S., Mahendrakar, N.S., Rao, D.N. and Amla, B.L. (1993). Effect of freezing, thawing and frozen storage on physico-chemical and sensory characteristics of buffalo meat. *Meat Sci.* 35: 331-340

Ziauddin, K.S., Rao, D.N. and Amla, B.L. (1995). Effect of lactic acid, ginger extract and sodium chloride onquality and shelf life of refrigerated buffalo meat. *J. Food Sci. and Technol.* 32(2): 126-128

Ziauddin, K.S., Rao, H.S. and Fairoze, N. (1996). Effect of organic acids and spices on quality and shelf life of meat at ambient temperature. *J. Food Sci. & Technol.* 33: 255-258

Appendix

COMPOSITION OF DIFFERENT MARINADE MIXES

g/100g of Meat

ITEMS	GROUP I %	GROUP II %	GROUP III %	GROUP IV %
Pepper		0.2	0.2	0.2
Chilly		1.0	1.0	1.0
Cinnamon		0.2	0.2	0.2
Corriander		0.5	0.5	0.5
Cumin/Anisi		0.5	0.5	0.5
Clove		0.05	0.05	0.05
Cardamom		0.1	0.1	0.1
Turmeric		0.05	0.05	0.05
Garlic		1.0	1.0	1.0
Ginger		2.0	2.0	2.0
STPP		1.0	1.0	1.0
Salt	1	1.2	1.2	1.2
Curd		5-10 ml	--	--
Limejuice			5-10 ml	--
Vinegar				5-8 ml

SCORE CARD FOR TASTE PANEL

Name of the product | Sample No. | Date | Type of cooking

Colour								Flavour								Juiciness								Tenderness								Overall acceptability							
1		2		3		4		1		2		3		4		1		2		3		4		1		2		3		4		1		2		3		4	
A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
																																Extremely good							
Appealing								Delicious								More juicy								Very tender and resilient								Very good							
																																Good							
																																Extremely fair							
Pleasing								Agreeable								Juicy								Less tender and resilient								Very fair							
																																Fair							
																																Poor							
Not so pleasing								Not so agreeable								Less juicy								Tough and no resilient								Very poor							
																																Extremely poor							

Name | Signature

SHELF - LIFE OF MARINATED RABBIT MEAT

By

G. JAYACHANDRA KAMATH

ABSTRACT OF A DISSERTATION

Submitted in partial fulfilment of the
requirement for the diploma

Post Graduate Diploma in Meat Processing Technology

Faculty of Veterinary and Animal Sciences
Kerala Agricultural University

Department of Livestock Products Technology
(MEAT TECHNOLOGY UNIT)
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
MANNUTHY, THRISSUR - 680651
KERALA

1997

ABSTRACT

Six Newzeland White crossbred rabbit were slaughtered and cut into suitable size. Cut-up parts were divided into 4 equal parts. Three marinades were prepared containing either curd, lime or vinegar, besides a control with salt alone. Samples were stored at $^{-}6°C$ and $^{-}20°C$ for 30 days period.

Samples were subjected to different parameters like pH on zero day and tyrosine value, TBA number, aerobic plate count and sensory evaluation on zero, 5th, 15th and 30th day of storage.

In this study, observed that the treatments had no significant effect on pH, tyrosine value, TBA number, aerobic plate count whereas storage period had significant effect on above parameters. Marination, storage period and temperature had significant effect on organoleptic qualities. The rabbit meat marinated with lime had lowest pH. Tyrosine value and TBA number obtained was lowest on zero day. On storage, the rabbit meat cuts treated with marinade gave higher scores in taste panel study. Treatment with lime juice was more expensive.