PROCESS OPTIMIZATION AND QUALITY EVALUATION OF SHIKAMPURI KEBAB

BY
Dr. P KRUSHEED B.V.Sc &A.H
I. D. No: GVM/2019-012

Thesis submitted to the
SRI VENKATESWARA VETERINARY UNIVERSITY

in partial fulfilment of the requirements for the award of the degree of

MASTER OF VETERINARY SCIENCE
(LIVESTOCK PRODUCTS TECHNOLOGY)
IN THE FACULTY OF VETERINARY SCIENCE

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY
NTR COLLEGE OF VETERINARY SCIENCE,
GANNAVARAM - 521102
SRI VENKATESWARA VETERINARY UNIVERSITY
TIRUPATI – 517 502. (A.P) INDIA

MARCH – 2022

CERTIFICATE

Dr. P. KRUSHEED has satisfactorily prosecuted the course of research and that the thesis entitled **"PROCESS OPTIMIZATION AND QUALITY EVALUATION OF SHIKAMPURI KEBAB"** submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part thereof has not been previously submitted by him for a degree of any University.

DATE:

Dr. J. INDUMATHI
Major Guide
Assistant Professor
Department of Livestock Products Technology
College of Veterinary Science
Tirupati
Andhra Pradesh.

CERTIFICATE

This is to certify that the thesis entitled **"PROCESS OPTIMIZATION AND QUALITY EVALUATION OF SHIKAMPURI KEBAB"** submitted in partial fulfilment of the requirements for the degree of **"MASTER OF VETERINARY SCIENCE"** of Sri Venkateswara Veterinary University, Tirupati, is a record of the bonafide research work carried out by **Dr. P KRUSHEED** under our guidance and supervision. The subject of the thesis has been approved by the student's advisory committee.

No part of the thesis has been submitted for any other degree or diploma. The published part has been fully acknowledged. All assistance and help received during the course of investigations have been duly acknowledged by the author of the thesis.

(Dr. J. INDUMATHI)

Chairman of the Advisory Committee

Thesis approved by the Student's Advisory Committee

CHAIRMAN : **Dr. J. INDUMATHI** ……………………………
Assistant Professor
Department of Livestock Products Technology
SVVU
Tirupati-517502.AP

MEMBER : **Dr. B. ESWARA RAO** ……………………………
Professor & University Head
Department of Livestock Products Technology
NTR College of Veterinary Science
GANNAVARAM-521102.AP

MEMBER : **Dr. T. SRINIVASA RAO** ……………………………
Professor & Head
Department of Veterinary Public health and Epidemiology
NTR College of Veterinary Science
GANNAVARAM-521102.AP

TABLE OF CONTENTS

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

ACKNOWLEDGEMENTS

When I look back to the odyssey to this stage, where I stand today with the kernel of my academic endeavour, I feel immensely indebted to all known and unknown forces who gave me strength to move on, and several learned souls, who enlightened my path through their knowledge and experience.

I express my gratitude and heartfelt thanks to my guide and chairman of the Advisory committee, ***Dr. J INDUMATHI****, Assistant Professor, Technical officer, COE Section Department of Livestock Products Technology, College of Veterinary Science, Tirupati for her involvement with originality and for her valuable suggestions for this research and excellent guidance. This work would not have been possible without her guidance, generous moral support and encouragement. I am grateful for her positive appreciation and counsel throughout the course of the research which led to the successful completion of the research work.*

I deem it a pleasure and privilege to place my profoundly indebted to the revered member of my Advisory Committee ***Dr. B. ESWARA RAO****, Professor and Univeristy Head, Department of Livestock Products Technology, NTR College of Veterinary Science, Gannavaram, for his neverending support at all times. His keen interest, critical appreciation in the execution of my work, inspiring guidance, constant encouragement, close counselling during my entire degree programme were priceless. And I am grateful for his valuable advice, constructive criticism, positive appreciation and counsel throughout the course of the research which led to the successful completion of the research work.*

I owe my heartful thanks to ***Dr. T. SRINIVASA RAO****, Professor & Head, Department of veterinary public health and epidemiology, NTR College of veterinary science, gannavaram, member of advisory committee for his constant help, encouragement, continuous motivation and indispensable suggestions throughout the period of study.*

No words to express my gratitude to ***Dr. E. NAGAMALLIKA****, Associate professor, department of livestock products technology, NTR College of Veterinary Science, Gannavaram, for her generous help, valuable suggestions, technical advice, and constant encouragement and motherly concern throughout the period of study. Her* *own zeal for perfection, passion, unflinching courage and conviction has always inspired me to do more. I am deeply grateful to her for giving me the strength and confidence not just to complete my studies but also to know moral values in my life.*

I gratefully acknowledge the help rendered by **Dr. V. Giridhara Rao** *Assistant Professor (Contractual), Department of LPT, NTR CVSc, Gannavaram for the knowledge and insights shared that helped me immensely during the time of my study.*

It gives me immense pleasure to express my deep sense of sincere gratitude to **Dr. G. Vijaya Bhaskar Reddy***, Assistant Professor & Head, Department of Livestock Products Technology, College of Veterinary Science, Tirupati.* **Dr. K. Sudheer***,* **Dr. Z. Naveen***, Assistant Professor, Department of Livestock Products Technology, Tirupati* **Dr. R. Sai Dilip Gupta***, Assistant Professor, Department of LPT, CVSc, Proddatur for their cooperation and valuable advises during my course of research.*

No research is possible without infrastructure, requisite materials and resources. For this I extend my thanks to Dean, SVVU, Tirupati and Associate Dean, NTR College of Veterinary Science, Gannavaram for their favour for extending support during my academics. I am also grateful to Sri Venkateswara Veterinary University for providing the financial assistance and opportunity to complete my post graduate study.

I am immensely thankful to my departmental colleagues **Dr. Shaik Sharmila** *and* **Dr.T. Jeswanth Reddy.** *for their kind co-operation and unreserved help during the course of study. I was fortunate enough to share joyful moments with them.*

I am distantly thankful to my seniors **Dr(s). Bidyuth prava Mishra, Vivekananda reddy, Prasanna, Shilpa sree, Gowtham and Zubair** *for their valuable help in research and suggestions at each step during the tenure of my study and research work and I am thankful to my juniors* **Vasu, Lohith, Girija, Roshni and Supriya** *for their cooperation during my research.*

I cannot forget friends who went through hard times together, cheered me on, and celebrated each accomplishment so it's my fortune to gratefully acknowledge the support of my friends **Dr(s). Kathyayini, K. Prathyusha, Rathna, Sravani, Vyshnavi Hemalata and Samata.** *They were always besides me during the happy and hard moments to push and motivate me.*

I take this opportunity to acknowledge the encouragement and motivation impacted to me by my colleagues ***Dr(s). Susmita, Narendra, Akhila mohan.***

It would be unfair without acknowledging the silent contributions of the people Mr. Musalaiah, lab technician and Nonteaching staff ***Mr. Yesubabu, Mr. Dayakar, Mr. Koteswara Rao Mrs. Satyavathi*** *Department of Livestock Products Technology.*

This journey would not have been possible without the support of my family. I acknowledge the people who mean a lot to me, my parents, ***Ahammad Vali & Smt.Muntaz Begum****, my Brother* ***Shameer,*** *my Elder Sister* ***Muneera****, my Brother-in-law* ***Gouse*** *my second sister* ***Ameena*** *and her other half* ***Minallah*** *and my Younger Sister* ***Gouseiah*** *and her fiancee* ***Mahaboob Basha****, my neice* ***Shaheed, Arshiya, Anikha, Mahira, Asiya, Aahirah*** *for showing faith in me and giving me liberty to choose what I desired. I salute you all for the selfless love, care, pain and sacrifice you did to shape my life. Although you hardly understood what I researched on, you were willing to support any decision I made. I would never be able to pay back the love and affection showered upon by my parents and family.*

My vocabulary utterly fails in expressing the accolade to my beloved one. I take this opportunity to dedicate this work to my love.

To all those who deserve such thanks for their direct or indirect help but I forget to mention their name; I apologize for omission of their name.

At-last but not the least, I bowhead in extreme regards to the omnipotent, omniscient almighty God, whose blessing enabled me to reach this destination.

Krusheed…

DECLARATION

I **Dr. P. KRUSHEED** hereby declare that the thesis entitled **"PROCESS OPTIMIZATION AND QUALITY EVALUATION OF SHIKAMPURI KEBAB"** submitted to Sri Venkateswara Veterinary University, Tirupati for the degree of **MASTER OF VETERINARY SCIENCE** is the result of original research work done by me. I also declare that the materials contained in this thesis have not been published earlier.

DATE **(P. KRUSHEED)**

PLACE: GANNAVARAM

Name of the Author	:	**P. KRUSHEED**
I.D No.	:	**GVM/2019-012**
Title of the thesis	:	**PROCESS OPTIMIZATION AND QUALITY EVALUATION OF SHIKAMPURI KEBAB**
Degree to which it is submitted	:	**MASTER OF VETERINARY SCIENCE**
Faculty	:	**FACULTY OF VETERINARY SCIENCE**
Major Advisor	:	**Dr. J. INDUMATHI** Assistant Professor Departmentof Livestock Products Technology SVVU Tirupati-517502.AP
University	:	**SRI VENKATESWARA VETERINARY UNIVERSITY, TIRUPATI**
Year of Submission	:	**2022**

ABSTRACT

Shikampuri kebab, an ancient ethnic meat product of Hyderabad. The mughals love for meat blended with the fiery spices of Andhra Pradesh which led to the creation of some of the best kebabs and other meat dishes of India. Shikampuri kebab of Hyderabad is also one such kebab recipe which hails from royal kitchens of the nizam. The proteins present in the egg have natural antimicrobial property and protect the product from the microbial spoilage and in addition it imparts acceptable pleasing flavour to the product. The aim of the current study was to prepare and optimize shikampuri kebabs with both chicken and mutton incorporated with different components of liquid egg as binder at different levels and to assess their physico-chemical, proximate, microbiological quality and storage stability.

In this study both the chicken and mutton shikampuri kebabs were prepared by utilizing different components of liquid egg i.e., egg albumen, egg yolk and whole egg each at three different levels (5%, 7.5%, 10%). The control was prepared in similar manner without using liquid egg. Trials were conducted for each level to select the best one based on the sensory attributes. Sensory evaluation of the product was performed by

a panel of six semi-trained judges and were selected 10% level as the most acceptable level.

The preparation of shikampuri kebabs with both chicken and mutton with different liquid egg components (egg albumen, egg yolk, whole egg) as binder at 10% level were used as treatments i.e., chicken without egg as C1, chicken with egg albumen as T1, chicken with egg yolk as T2, chicken with whole egg as T3 and mutton without egg as C2, mutton with egg albumen as T4, mutton with egg yolk as T5 and mutton with whole egg as T6. The preparations were subjected to sensory, proximate and quality analysis and the results revealed that the chicken shikampuri kebab with whole egg (T3) and mutton shikampuri kebab whole egg (T6) had significantly ($P<0.05$) higher sensory scores like appearance, flavour, texture, juiciness and overall acceptability, cooking yield than the other components of addition and control and thus it was selected for further study. The selected product along with control which were packed aerobically in LDPE pouches and stored at refrigeration (4±1°C) temperature. The selected formulations were further assessed for their physico-chemical, microbiological analysis and sensory evaluation. The kebabs were stable up to 12 days and found spoiled on 14th day of storage at refrigerated (4 ± 1°C) temperature.

Based on the above study it was concluded that the pH values were non significantly ($p<0.05$) higher than the control. The batter stability values were non significantly ($p<0.05$) affected with increase in the storage period. The tyrosine, 2 - thiobarbituric acid reactive substance values, total plate and yeast and mould counts increased significantly ($P<0.05$) with storage period. Sensory scores like appearance, flavour, meat intensity flavour, texture, juiciness, and overall acceptability values decreased with the advancement of storage period. This study brought out the process for both chicken and mutton shikampuri kebab preparation in a standardized procedure and documented the traditional methodology for shikampuri kebab liquid with egg as binder.

LIST OF SYMBOLS AND ABBREVIATIONS

%	:	Per cent
FAO	:	Food and Agriculture Organization
°C	:	Degree Celsius
µg	:	microgram
AOAC	:	Association of Analytical Chemists
g	:	gram
i.e.	:	that is
Kg	:	Kilogram
LDPE	:	Low density poly ethylene
Log	:	logarithm
M	:	Molarity
Meq	:	milliequivalents
mg	:	milligram
ml	:	milliliter
N	:	Normality
NaCl	:	Sodium Chloride
NaOH	:	Sodium hydroxide
PCA	:	Plate count agar
PDA	:	Potato dextrose agar
pH	:	Negative logarithm of hydrogen ion concentration
SE	:	Standard error
SPC	:	Standard Plate Count
C1	:	Chicken control
C2	:	Mutton control
T_1	:	Chicken with egg albumen
T_2	:	Chicken with egg yolk
T_3	:	Chicken with whole egg
T_4	:	Mutton with egg albumen
T_5	:	Mutton with egg yolk
T_6	:	Mutton with whole egg
TBARS	:	Thiobarbituric acid reactive substance

HCl	:	Hydrochloric acid
TBHQ	:	Tertiary butyl hydroquinone
TPC	:	Total plate count
TBC	:	Total bacterial count
TPSC	:	Total psychrophilic counts
TVC	:	Total viable count
Viz	:	namely
w/w	:	weight/ weight
W.H.O	:	World health organization
WHC	:	Water-Holding Capacity
Y&M	:	Yeast and moulds
% wt	:	Percent weight
Sec.	:	seconds
CP	:	Crude protein
CFU/g	:	Colony forming unit per gram
<	:	Less than
>	:	Greater than
≤	:	Less than or equal to
l	:	Liter
OD	:	Optical density
Fig	:	Figure
±	:	Plus or minus
MDA	:	Malonaldehyde
TCA	:	Trichloroacetic acid

Chapter – I

INTRODUCTION

CHAPTER I

INTRODUCTION

Meat and meat products are important sources of protein, B complex vitamins and trace elements in human diet and their consumption depends on socio-economic factors, ethics or religious beliefs, and traditions. In the meat processing industry the inclusion of non-meat ingredients in meat products are considered an important strategy for reducing overall production costs, while maintaining nutritional and sensory qualities of the end products (McWatters. 1990). Due to changes in life-styles of people, the present-day demand is towards ready to eat convenience meat products. In addition, people's awareness and knowledge levels of them have also increased and the demand for minimally processed foods has increased. From this point of view, food producers and food scientists have been conducting necessary studies to ensure food safety with minimal processing while producing ready to eat products in order to meet consumers' requirements.

Chicken meat is known by its nutritional quality, as it contains significant amount of high-quality and easily digestible protein and a low portion of saturated fat. Therefore, chicken meat is recommended for consumption by all age groups. Fresh chicken meat and chicken products are universally popular because they are relatively cheaper in cost, high nutritional value.

The most commonly consumed red meat in our country is mutton. Mutton is rich source of high-quality protein providing all nine essential amino acids, an outstanding source of many vitamins and minerals and also contains varying amounts of fat. It is a source of long-chain omega-3 polyunsaturated fats, riboflavin, pantothenic acid, selenium and vitamin D. Mutton is an excellent source of Vitamin B6 (pyridoxine), Vitamin B12 (cobalamin), Vitamin B3 (niacin), iron, zinc and phosphorus (Williams *et al*. 2007; McAfee *et al*. 2010). It is also sources of a range of endogenous antioxidants and other bioactive substances including taurine, carnitine, carnosine, ubiquinone, glutathione and creatine.

During recent years, the importance of traditional meat products has been surged due to the cultural and financial values. Traditional meat products are high sensory quality foods, usually with high nutritional value, produced in a small-scale utilizing ingredients and procedures from ancient times (Nayar *et al*. 2021). Traditional foods are prepared depending on the availability of raw materials and local taste preferences (Laranjo *et al.* 2017). Indian traditional foods are also recognized as functional foods because of the presence of functional components such as anti- oxidants, dietary fibers and probiotics. These functional molecules help in weight management and blood sugar level balance and support immunity of the body (Azad *et al.* 2016).

Meat varieties appear in the diet of more people throughout the world. It is important in human diet because they provide most of the essential elements (Demirezen and Uruc 2006). Processing is an art to enhance the quality of foods. At present, it is the thrust area for new product development. In meat industry, number of processing techniques like portioning, deboning, size reduction, seasoning, tenderization, marination, tumbling, reforming, emulsion stuffing and cooking are being followed for conversion of meat into diversified value-added products (Barbut, 2015). In fast food sector, these techniques play a significant role in development of processed and modified meat products that suit to the requirement of present generation whose life style is very fast and highly mechanized.

Further, with change in food habits of consumers in Metros and big cities, the demand for such products has been increased considerably. Looking to this, several meat processors like Kentucky Fried Chicken (KFC), Mc Donald's, pizza hut, wimpy *etc.* are coming forward for production of meat-based value-added products such as Kebab, sausages, steaks, meat balls, frankfurters, patties breaded, coated and marinated snacks, canned chicken curry, meat soup, sandwich, pizza, burger and nuggets including ready to cook or ready to eat products *etc.*, These products in turn are going to change the palatability of consumer. Among the meat based comminuted products, Kebab which is more acceptable worldwide occupies, a predominant place due to its characteristics flavour and pronounced chewy texture Kraig and Sen (2013).

Now a days, a large variety of non-meat ingredients like skimmed milk powder, dried whey, sodium caseinate, flours of wheat, oat, rice, corn, pea, liquid egg *etc.* have been utilized as binders or extenders in comminuted meat products like Kebab, burger, patties, sausages *etc.* which not only reduces the formulation cost but also improve their quality attributes such as emulsion stability, water binding properties, slicing characteristics and to reduce cook loss Bhat *et al*. (2013a). The non-meat ingredients (additives) can also alter or improve the appearance, texture and palatability of finished products. Several additives have been tried to enhance the functional and emulsifying properties of processed meat products Kyriakopoullou *et al*. (2021).

Eggs are nutritious, inexpensive meat substitute, low in calories and can be used in a wide variety of recipes. With the induction of fast-food culture and change in traditional food habits, the consumer preference is continuously shifting, the egg product sector not being an exception (Mehta *et al.* 2015; Pandey and Yadav. 2011). There has been an increasing trend in consumption of egg and egg products. Eggs are one of the best-known food additives with excellent nutritional, functional and emulsion properties.

Therefore, several workers have made use of these functional properties of eggs in comminuted meat products in order to improve the physico-chemical and sensory properties (Baker *et al*. 1968; Kondaiah and Panda, 1989; Gupta *et al*. 1993). Apart from the functional properties, eggs also have antimicrobial (Akashi, 1971; Wang and Shelef. 1991) and antioxidative effects (Lu and Baker. 1986). Interestingly, these properties of egg components were not affected by simple pasteurisation (Lu and Baker. 1986). This antimicrobial and antioxidative effects of egg components have been effectively utilised in meat products (Yamamoto *et al*. 1990).

Legume consumption is a usual and beneficial part of the human diet and contributing to health. They are essential source of protein, carbohydrates, dietary fibre, micronutrients and various phytochemicals Kamboj and Nanda (2018). Consumption of legumes reduces the risk of cardiovascular disease, some cancers like colon, breast and prostate and also helps to manage body weight due to its satiety value. Legumes possess some significant health protective compounds such as inositol phosphates and phenolics. In some countries complementary diets based on cereals, tubers and root along with legumes is recommended as best solution for undernourishment. This reveals that legumes have prospective role in improving the nutritional status of malnourished persons (Mudryu *et al.* 2014). A number of legumes (non-meat proteins) have been used as binders and extenders in comminuted meat products to improve stability, yield, textural palatability and cost of meat products. Common edible legumes comprise broad beans, dry beans, chickpeas, dry peas, lentils, lupins, mung beans, soybeans, sprouts, lotus, peas, green beans and peanuts Kamboj and Nanda (2018).

Kebabs are usually associated with the advent of the mughals in India (Ram and Sharma 2018). The Mughals love for meat blended with fiery spices of Andhra Pradesh which led to the creation of the best kebabs and other meat dishes of India. Shikampur or shikampuri kebab of Hyderabad is also one such recipe which hails from the royal kitchens of the Nizam. The word shikam means belly in urdu and pur means full. shikampur thus literally means filled up belly, possibly because the meat patties are stuffed in the centre of the kebab with hung curd, chopped onions, green chillies, mint, coriander leaves. This is to add to the dish a little tanginess or khattapan that Hyderabadi cuisine is known for, and these kebabs are soft, delicate in texture, which gives a melt in the mouth experience as compared to shami kebabs which are usually more fibrous. Shikampuri kebabs were carried as typical safari khana or travel food in Hyderabad during earlier times. These kebabs are prepared with boneless pieces of beef or mutton and are cooked with soaked chana dal as well as selected spices.

Limited information is available on shikampuri kebabs with both chicken meat and mutton in India. Therefore, the present study was undertaken to evaluate the effect of liquid egg as binder in shikampuri kebab on the quality characteristics and sensory profile and standardize the preparation of shikampuri kebabs with both chicken meat and mutton and to evaluate its shelf-life at refrigerated (4±1ºC) temperature. Looking to the scope, the present study was planned with the following objectives.

Objectives of Investigation:

1. Standardization of methodology for preparation of Shikampuri Kebab.
2. To determine the best suitable formulation of both chicken meat and mutton to enhance the sensory quality of Shikampuri Kebab.
3. To study the effect of incorporation of liquid egg as binder on the quality characteristics of Shikampuri Kebab.
4. To evaluate the shelf-life of the product at refrigerated (4±1ºC) temperature.

Chapter – II

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

2.1 CHICKEN

Broiler meat is more tender and juicy up to 6 weeks of age because of less collagen content (Abe *et al.* 1996). With the advancement of age, meat becomes poor in flavour, juiciness and other sensory attributes (Bailey, 1984, Lawrie, 1991).

Tong *et al.* (2014) studied to evaluate the effect of free-range days on growth performance, carcass yield, meat quality and lymphoid organ index of a local chicken breed and stated that increasing free-range days advantageously affects breast yield, while decreasing thigh, leg, thigh bone and foot yields as well as the water-holding capacity of thigh. No evidence was found that increasing free-range days caused changes in growth performance, meat quality, and lymphoid organs.

Tong *et al.* (2015) studied to evaluate the effect of outdoor access days on growth performance, carcass yield, meat quality, and lymphoid organ index of a local chicken breed and stated that increasing outdoor access days advantageously affects the body weight, daily weight gain, feed per gain and breast yield as well as the light (L$*$) and red (b$*$) values of leg meat colour, while decreasing foot yield.

Michalczuk *et al*. (2016) studied to determine growth performance, meat quality and oxidative changes in breast muscles depending on the genotype and age of broiler chickens and stated that the fast-growing chickens achieved the highest daily gain and daily meat weight gain compared with the medium-growing chickens and the slow-growing experimental line.

Farzana *et al.* (2017) studied the meat yield and quality characteristics of commercial broiler and indigenous chicken and found higher carcass weight and dressing percentage for broilers than indigenous chicken.

2.2 MUTTON

Griffin *et al*. (1992) compared three sheep breeds and two goat breeds and evaluated by two untrained sensory panels for flavour, juiciness, tenderness and overall palatability and suggested that sheep meat is more palatable than that of goat meat.

Schonfeldt *et al*. (1993) compared the quality characteristics of goats and sheep carcases and found that sheep meat had more intense aroma, more tender, contains less fibrous tissue residue and the species flavour was more pronounced than that of goat meat and also confirms the fact that the meat of younger animals was more tender, contains less fibrous tissue residue and the species flavour was less typical than that of older animals and this was irrespective of whether it was obtained from sheep or goat.

Tshabalala *et al.* (2003) analysed carcass, proximate, fatty acid composition and sensory characteristics of two different breeds of sheep and goat and found sheep breeds yielded more dissectable fat and lean and less bone as a percentage of carcass weight than goat breeds. Further concluded that the patties made from sheep meat were more tender, juicy, greasy and less chewy compared to chevon patties.

Sen *et al.* (2004) compared carcass composition and meat quality attributes in yearling sheep and goats and stated that the yearling sheep had higher ($P<0.05$) pre slaughter weight, hot carcass weight and dressing % than the goats and the muscular development as indicated by loin eye area was significantly ($P<0.01$) greater in sheep than goats. Similarly, the dissected total fat of half carcass was also more ($P<0.01$) in sheep than the goats.

Lee *et al*. (2008) conducted an experiment to compare the chemical composition and quality characteristics of goat and lamb raised under similar conditions and no difference (P>0.05) in moisture, protein, and fat percentages between the *Longissimus* muscle of goat and lamb. However, the ash content in the *Longissimus* muscle of goat (1.73%) was higher (P<0.05) than that of lamb (1.17%). Further found no significant (P>0.05) difference in the values of TBARS and cooking loss between chevon and lamb chops.

Wang *et al*. (2021) investigated the carcass traits and meat quality of lambs reared under different feeding systems and concluded that proper grazing time can improve both quality and quantity of lamb meat.

2.3 CONSUMPTION PATTERN OF MEAT

Babu *et al*. (2010) studied the meat consumption patterns in rural household of Chittor district of Andhra Pradesh revealed that most of the people preferred poultry meat (70%) followed by mutton (21%) chevon (7%) and very less percentage of people preferred to take pork (1%) and beef (1%).

Chandrasekaran and Sureshkumar (2014) carried out a study on sheep and goat meat consumption pattern in Salem City Corporation and revealed that chicken and chevon were the most preferred meat types with 53 and 48 respondents out of 60 respondents and then followed by fish and mutton with 46 and 3 respondents respectively. The study revealed that there were no respondents for beef and pork from all 60 correspondents.

Suresh (2016) studied the consumer attitude towards meat consumption from Delhi and Hyderabad cities and revealed that more than half of the respondents (51.2%) preferred mutton for its perceived nutritional value and health benefits.

Rao *et al.* (2017) studied the consumption pattern in and around rural locality of Gannavaram, Andhra Pradesh and concluded that most of the respondents are consuming chicken when compared to mutton, chevon and beef.

Kiran *et al.* (2018) carried out a study on consumption pattern, consumer perception and consumer attitude on meat quality and safety in southern India and revealed that chicken meat (53.1%) was most preferred by household and mutton (27.7%) was ranked second for meat of choice and beef (7.3%) was least preferred by majority of households.

Srinivas *et al*. (2018) conducted a survey on consumption of chicken meat and egg in rural household of Jagitial district of Telangana state and revealed that most of the people preferred chicken meat (83.7%) followed by mutton and chevon (13.7%) and very less percentage of people preferred to take pork (1%) and beef (1%).

2.4 LIQUID EGG AS BINDER IN MEAT PRODUCTS

Gujral *et al.* (2002) investigated the effect of liquid whole egg fat and textured soy protein on the textural and cooking properties of raw and baked patties from goat meat and noticed improved juiciness and lowered cooking losses in patties added with liquid whole egg.

Kalaikannan *et al.* (2007) studied the effect of incorporation of whole egg powder, dried albumen and dried yolk in chicken patties, those were packaged in LDPE pouches and concluded that addition of egg powders significantly enhanced the emulsion stability (ES) and product yield with control.

Dushyanthan *et al*. (2008) studied the processing of buffalo meat nuggets utilizing different binders like maida, soy flour, whole egg, and liquid whey each at different levels and stated that 7% maida and 1%whole egg, 3% soy flour and 3% liquid whey have highest emulsions stability, product yield, overall acceptability scores.

Sudha *et al*. (2008) studied the comparative effect of whole egg liquid and skim milk powder on physico-chemical and sensory characteristics of pork patties and stated that the whole egg liquid was considered better than the skim milk powder as a suitable binder and also stated that emulsion stability and the product yield were significantly ($P<0.01$) higher in patties incorporated whole egg liquid.

Suradkar *et al*. (2012) reported that sensory and quality attributes of chicken nuggets improved considerably with incorporation of whole egg liquid to the extent of 15 percent.

Adzitey *et al*. (2014) studied the suitability, yield and cohesiveness, sensory characteristics and nutritional composition of beef burger formulated with chicken whole egg as a binder, stored at 4°C and stated that there is no negative effect on the eating qualities of processed meat products when used in quantities of 50g to 150g of egg.

Adzitey *et al*. (2016) studied to determine the cohesiveness of whole guinea fowl egg as a binder in chevon and beef burgers and the processed samples were evaluated for their sensory, nutritional and binding properties and stated that the burgers with the highest inclusion level (9 %) of whole guinea fowl egg were most preferred.

Ossom *et al.* (2016) stated that cohesiveness of the beef burgers improved when the egg albumen is used as the binder, thus fresh albumen can be used as binder at inclusion levels of 18%, 22.5% and 27% without any adverse effect on eating quality and acceptability of the prepared product and it does not increase the level of crude protein.

Martina (2017) studied the effect of incorporation of whole egg liquid on physico-chemical and sensory parameters of aerobically packaged chicken cutlets with its control and stated that the incorporation level of 7.5% whole egg liquid was found to be optimum for preparation of acceptable cutlet, which could be stored safely in low density polyethylene pouches at refrigeration temperature (4±1°C) for 6 days.

2.5 TRADITIONAL MEAT PRODUCTS

Anjaneyulu *et al.* (2008) discussed about the further developments in quality improvement, processing, consumption as well as demand, problems and prospects of these traditional/heritage meat and poultry products.

Kilic (2009) reported the results of research and technological improvements achieved during the past decade in the field of traditional turkish meat products which are having economic value.

Rai *et al.* (2009) documented the traditional knowledge of the ethnic Himalayan people on preparation of various traditionally processed sausages and meat products such as Kargyong, Kheuri, Satchu, Suka Ko Masu, Chilu, Chartayshya, Gemma and Arjia.

Petrovic *et al.* (2011) investigated on traditional dry fermented sausages of Serbia in order to standardize the production procedure and to understand physical, chemical, biochemical and microbiological changes occurring during spontaneous fermentation of these products in traditional manufacturing process.

Santos *et al.* (2011) investigated on polycyclic aromatic hydrocarbons contents in Portuguese traditional smoked meat products and concluded that Blood sausages are more risky, since total polycyclic aromatic hydrocarbons contents were generally higher and because of its presence in inner parts were significantly superior than that found in casings, comparatively to meat counterparts, which expressed superior benzo[a]pyrene toxic equivalents.

Anandh *et al.* (2012) observed that traditional styled fried tripe products prepared from buffalo and goat tripe had better physico-chemical, microbial qualities and sensory scores were rated moderate to highly acceptable.

Salahuddin *et al*. (2013) worked to improve the traditional technology of meat products in Jammu and Kashmir including their production, research and development initiatives. Wide variety of traditional meat products produced in Jammu and Kashmir were collectively known as wazwan which include Rista, Goshtaba, Nate-Yakhni, Aab-Gosh, Dopyaza, Tabaq-Maz, Methi-Maz, Dhani, Rogan-Josh, various Kababs and Kormas etc.

Azad *et al*. (2016) worked on standardization of traditional preparation of bamboo chicken–an ethnic low fat meat product of coastal Andhra Pradesh and found that bamboo chicken can be prepared with locally available *Dendrocalamus strictus* bamboo, on liquid petroleum gas flame with the use of broiler chicken and can be stable up to 3 days at refrigeration temperature (4 ± 1 °C).

Chandirasekaran and Rajan (2016) evaluated the retort processed, Indian traditional type chettinad chicken product and reported that the retort processed chettinad chicken prepared from spent chicken and broiler breeder meat can be safely stored up to 180 days at ambient temperature (35 ± 2°C).

Gagaoua and Boudechicha (2018) worked on the ethnic meat products of the North African and mediterranean countries and discussed about the common eating practices of the products and the related historical and socio-cultural aspects.

Haritha (2019) worked on the quality characteristics and storage stability of Gongura chicken a traditional meat preparation of coastal AP prepared using different forms of *Hibiscus cannabius L.* and *Hibiscus sabdariffa* L. and concluded that the product was stable up to 24 hours at ambient (24±1°C) and 20 days at refrigerated (4±1°C) temperature respectively.

Indumathi *et al*. (2020) evaluated the effect of three different levels (20,40 and 60%) of gongura incorporation on the quality of mutton curry at refrigeration (4±1°C) temperature for 20 days based on the proximate composition, pH, thiobarbituric acid reactive substance (TBARS), free fatty acid value (FFA), sensory attributes and microbiological assay and concluded that mutton curry with gongura has better acceptable sensory quality characteristics up to 20 days of storage at refrigeration.

2.6 KEBABS

Hussain *et al.* (2006) concluded that the vacuum packaging with and without gamma irradiation was found to have no effect on the shelf-life extension of beef kebabs.

Modi *et al*. (2007) examined the quality changes in dehydrated chicken kebab mix during storage and stated that the dehydrated kebabs had low bacterial and coliform counts throughout the storage period.

Bhat *et al.* (2013a) studied the quality characteristics of microwave cooked chicken seekh kebabs extended with different non-meat proteins and stated that the extended chicken seekh kababs could be conveniently packed in LDPE for a period of 21 days in refrigerated (4±1°C) condition without any marked loss of physico-chemical, microbial and sensory quality.

Bingol *et al.* (2013) stated that the microbial growth in doner kebab was delayed due to the lack of oxygen in the package, which prevented the increase of lipid oxidation and improved the consumer acceptance.

Pandey *et al.* (2014) investigated on physico-chemical and textural properties of shami kebab prepared by deep fat frying and grilling at varied time and temperature of processing and found that temperature of the oil, duration of frying and kebab surface (coating) greatly affect the final texture, flavour, and quality attributes.

Panozzo *et al.* (2015) studied the nutritional value and energy content of the ready to eat food and stated that the nutritional quality of kebabs were mainly influenced by the abundance of meat used in preparation of product.

Simsek and Kilic (2020) stated that incorporation of encapsulated polyphosphate improved the storage stability of doner kebabs without significant negative impact on pH, fatty acid profile, proximate composition and textural properties.

2.7 PHYSICO-CHEMICAL PROPERTIES OF MEAT PRODUCTS:

2.7.1 pH

The pH is one of the most important physico-chemical properties of meat which influences quality characteristics such as emulsifying capacity, emulsion stability, cooking loss, meat colour, juiciness, flavour, water holding capacity, texture and drip loss. (Hellendooren,1962; Swift and Sulzbache,1963).

Jay (1972) found that the decrease in pH value in meat be attributed to breakdown of glycogen with formation of lactic acid and increased pH due to the partial proteolysis leading to the increase of free alkaline groups depending on the condition of such changes.

Babji *et al.* (2000) deliberate the various quality changes in refrigerated minced chevon stored under vacuum and aerobic packages. They reported the decline in trend in pH from 6.53 to 6.25 with the increase in the storage period from 0 to day 21.

Ahamed *et al*. (2003) conducted a physico-chemical evaluation of dressed broiler at refrigerated temperature and found that pH values of the samples were in increasing trend with increase in storage period at 5-7°C.

Kandeepan and Biswas (2007) studied the effect of low temperature on quality and shelf life of buffalo meat opined that the pH of buffalo meat showed an upward trend with the increase in the storage period. On 4^{th} day the pH of stored buffalo meat at 4°C was almost equal to that of meat stored at -10° C however on 14^{th} day of frozen storage, the pH increased significantly in both meat samples and pH values increase with increase in storage period.

Nagamallika *et al.* (2006) worked on the effect of storage on the sensory, microbial and physico-chemical characteristics of chicken patties and concluded that the pH of partially cooked spent hen meat patties was increased during frozen storage and decreased during refrigerated storage.

Dushyanthan *et al*. (2008) studied the processing of buffalo meat nuggets utilizing different binders like maida, soy flour, whole egg and liquid whey each at different levels and stated that there was an increase in product pH over emulsion pH and this might be due to the protein denaturation, formation of new cross linkages and reduction in acidic groups during cooking in the temperature range of 55-80°C.

Sasse *et al.* (2009) investigated the cooked ground pork patties containing natural to synthetic antioxidants for prevention of lipid oxidation during frozen storage for 6 months and observed an increase in pH from 6.3 on 0 day to 7.0 at the end of 6 months period.

Rai *et al.* (2010) studied microbiological parameters of ethnic meat products of the eastern Himalayas and reported that the mean pH values ranged from 5.3 to 6.9 in all the traditional meat products with Suka Ko Masu having the lowest pH (5.3).

Mood *et al*. (2016) deliberate the changes of pH throughout chicken meat stored in air at 0, 4, 10, 15°C and observed that the pH values increasing with the raise of storage temperature.

Martina (2017) studied the effect of incorporation of whole egg liquid on physico-chemical and sensory parameters of aerobically packaged chicken cutlets with its control and stated that the pH with 7.5% whole egg liquid was significantly ($p<0.05$) higher than that of control and increased significantly ($p<0.05$) on 9th day of storage at refrigeration temperature (4±1°C).

Ramakrishnan *et al*. (2017) studied the effect of different storage conditions on chicken carcass quality characteristics and found a highly significant ($P \leq 0.05$) difference in pH values between the storage conditions and period.

2.7.2 Cooking Yield

Improvement in cooking yield was observed in mutton and combined mutton plus chicken sausages using whole egg liquid (Gupta *et al.* 1993) and cooked chicken gels using egg albumen (Dawson *et al.* 1990).

Anjaneyulu *et al.* (1990) reported that higher values of emulsion stability and cooking yield in chicken patties which could be due to higher pH of chicken meat.

Kumar and Sharma (2005) stated that cooking yield of chicken patties extended with 5 %, 10 % and 15 % sorghum flour was significantly better ($P<0.05$) as compared to control patties.

Thomas *et al.* (2006) while preparing pork sausages observed significant reduction in product yield, with addition of increasing level of glucono-delta lactone (GDL).

Modi *et al.* (2007) studied the quality changes during the storage of dehydrated chicken kebab mix and stated that deep fat frying of kebab resulted in frying yield within the range 85.8 % - 86.2 % with the storage period having a marginal ($P \geq 0.05$) effect on frying yield.

Anjaneyulu *et al*. (2008) studied the Indian traditional meat products and their processing, quality, present scenario and future prospects and reported that meat cooked quickly to an internal temperature (75 ± 2°C) has a lower cooking loss and are juicer than those cooked slowly at the same temperature and found that cooking temperature and time positively influence the sensory attributes.

Mendiratta *et al*. (2008) conducted a study on comparisons of handling practices of culled sheep meat for production of mutton curry and revealed that cooking yield was significantly ($P<0.05$) higher when meat cooked within 2 to 3 hours of slaughter than frozen and thawed samples.

Kandeepan *et al*. (2011) reported that the buffalo meat curry stored at ambient temperature increased their pH than refrigerated temperature.

Alina *et al.* (2012) conducted study on the effect of grilling and roasting on the fatty acids profile of chicken and mutton and reported that the total fat content and cooking loss were high in grilling than roasting. Cooked chicken meat had a lower proportion of monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA) and saturated fatty acids (SFA) than cooked mutton. PUFA/SFA ratio decreased in chicken meat and increased in mutton meat by heating.

Martina (2017) studied the effect of incorporation of whole egg liquid on physico-chemical and sensory parameters of chicken cutlets with its control and stated that the product yield prepared with 7.5% whole egg liquid was significantly ($p>0.05$) higher than that of control, this might be attributed to the increase in water retention in the meat matrix.

Hidayat *et al.* (2018) investigated the physico-chemical, sensory attributes and protein profile by SDS-PAGE of beef sausage substituted with texturized vegetable protein and reported that the water holding capacity and cooking yield will increase during the substitution of meat with texturized vegetable protein in sausage products ($P<0.05$).

2.7.3 Batter stability

Clarke *et al.* (1988) reported that alginate added structured beef rolls had higher batter stability than salt-phosphate structured rolls.

Charged alginate polymers in meat system compete for water to form a viscous sol or visco-elastic gel, thereby interfering with their structure-forming ability and gel matrix formation (Tolstoguzov, 1991).

Gordon *et al.* (1992) addition of salt, polyphosphates and mechanical agitation causes extraction of salt soluble proteins create a fine protein matrix in homogenous batter and binding of meat chunks, thus stabilize the batters during further processing and cooking of meat products.

In structured beef, Xiong, (1994) reported that addition of connective tissue reduced the stability of beef batters. Hughes *et al.* (1997) found increased emulsion stability in frankfurters formulated with carrageenan and 0.7% carrageenan incorporation resulted in the highest (P<0.05) emulsion stability (as total volume released) compared to 0.5% and controls.

Lin and Keeton, (1998) found that alginate added beef patties had more stable batters than carrageenan added patties. Candogan and Kolsarici, (2003) found the addition of carrageenan had highest stability compared with carrageenan with pectin gel, high fat control and low-fat control of frankfurter system. Addition of k-carrageenan significantly decreased the percentage of water loss from gel samples after centrifugation and improved water retention of meat gels (Pietrasik, 2003).

The stability for restructured buffalo meat batter was significantly lower (P<0.01) than that of the emulsion form (Thomas *et al.* 2006). Yapar *et al.* (2006) stated that with the increase in tumbling time, the emulsion stability increased which might be due to better stabilization of emulsion with time and thus improving the cooking yield.

Reddy (2011) studied the effect of meat particle size on the batter stability of restructured mutton batter and concluded that small particle size of meat resulted in high batter stability compared to large particle size of meat.

Vivekananda reddy (2019) reported that the restructured buffalo meat slices processed with vacuum tumbling along with massaging had significantly (p<0.01) higher batter stability compared to the product processed with hand mixing massaging and vacuum tumbling alone.

2.7.4 Thiobarbituric acid reactive substance (2-TBARS)

Witte *et al*. (1970) reported an increase in TBA values of pork and beef upon 2-7 days of storage at 4˚C.

According to Gray *et al*. (1996) lipid oxidation in stored meat is associated with undesirable off-flavour, toxic substance and discolouration and is a principal contributing factor to the decline in meat freshness and quality.

Mandal *et al*. (2002) found a significant $p \geq 0.05$increase in TBA value, indicating an increase in lipid oxidation during storage reflecting on the organoleptic quality of the restructured cured chicken meat during refrigerated storage.

Modi *et al*. (2006) reported that oxidised flavour could not detect sensorily even when thiobarbituric acid value were around 2.4 mg malonaldehyde/kg and concluded that this could be because of the masking of the flavour by spices in chicken curry.

Kandeepan *et al*. (2011) documented that TBARS values increased significantly ($P \leq 0.05$) in spent buffalo meat curry stored at ambient temperature compared to their counterparts during 3 days refrigerated storage.

Bhat *et al.* (2013a) studied the quality characteristics of microwave cooked chicken seekh kebabs extended with different non-meat proteins and observed a significant ($P<0.05$) linear increase in TBARS from day 0 to 21.

Bhat *et al*. (2013b) studied the quality characteristics of chicken meat balls under refrigeration (4±1ºC) storage and found significantly ($P<0.05$) increased TBARS values during storage.

Kanatt *et al.* (2013) investigated on the Effects of chitosan coating on shelf-life of ready-to-cook meat products during chilled storage and reported that the samples coated with 2 g/100 ml chitosan and stored for 14 days have retarded lipid oxidation in all the meat products during storage.

Singh *et al*. (2015) studied the effect of sorghum bicolour on the quality characteristics of chevon to evaluate the effect of clove oil on the storage quality of aerobically packaged chevon cutlets and stated that thiobarbituric acid-reactive substance value (mg malonaldehyde/kg) showed a significant increasing trend (P<0.05) with the increasing days of storage.

Talukder *et al*. (2015) studied the development and quality characterization of mutton snack and stated that the TBARS values increased significantly (P<0.05) throughout the storage period at room temperature indicating an increase in lipid oxidation.

Chandirasekaran and Rajan (2016) worked on retort processed, Indian traditional type Chettinad chicken product and stated that the TBA values increased significantly (P<0.01) during the storage and this might be due to residual oxygen remaining in the pouch as the pouches were not vacuum sealed.

Martina (2017) studied the effect of incorporation of whole egg liquid on physico-chemical and sensory parameters of aerobically packaged chicken cutlets with its control and stated that the TBA value and free fatty acids increases with increase in storage period of 9 days at refrigeration temperature (4±1°C).

Thamizhannal *et al*. (2017) studied the photolytic changes in the chicken meat under different packaging conditions and reported that TBA of chicken meat increases with increase in storage period irrespective of packaging material.

2.7.5 Tyrosine Content

Pearson (1968) demonstrated that the "tyrosine" value of meat increased with storage time along with total volatile nitrogen until amino acid deamination by the aerobic metabolism of Pseudomonads limited formation of free amino acids. Further indicated that "tyrosine" value also measured other reductants soluble in trichloroacetic acid such as tryptophan, cysteine, phenolics, sulfhydryls etc. Increased tyrosine values in beef during storage due to the formation of free amino acids from denaturation process.

The degree of autolysis and bacterial proteolysis in meat could be measured as tyrosine value which actually determined the quantity of amino acid - tyrosine and tryptophan present in an extract of meat (Strange *et al.* 1977). Tyrosine value was used as one of the methods for detecting the microbial spoilage in meats, poultry and sea food (Jay. 1996).

Strange and Benedict (1978) stated that the tyrosine levels were influenced by the bacterial population and the duration of storage of meat samples.

Jayanthi and Venkataramanujam (2006) found no significant changes due to packaging methods, storage period and their interaction on tyrosine value of chevon stored during refrigeration temperature.

Kandeepan *et al*. (2006) investigated the effect of low temperature on quality and shelf-life of buffalo meat and stated that the tyrosine value of buffalo meat increased significantly ($P<0.05$) with increase in storage period.

Rajan *et al*. (2014) conducted a study on preparation and storage stability of retort processed chettinad chicken and stated that tyrosine value increased significantly ($p<0.01$) during storage at ambient temperature.

Shukla *et al.* (2015) evaluated the shelf life of buffalo meat using physico-chemical parameters for 9 days in polystyrene foam trays which were covered with PVC film to store at refrigeration temperature and were analysed on alternate days i.e. on the 0^{th}, 3^{rd}, 5^{th}, 7^{th} and 9^{th} days. The tyrosine values increased significantly ($P<0.05$) during refrigerated storage.

Biswas *et al*. (2017) studied on comminuted meat products prepared from spent chicken during storage at refrigeration (4±1ºC) and frozen temperature (-18ºC) under aerobic packaging conditions and revealed that the tyrosine value of all comminuted meat products increased with the progress in storage period during refrigerated and frozen storage.

Thamizhannal *et al*. (2017) studied the proteolytic changes in chicken meat under different packaging conditions and reported that the fresh chicken drumsticks stored at (4±1ºC) in the refrigerator had an initial tyrosine value (mg of tyrosine /100g) of 10.07 ± 1.22 on day 0 and also stated that tyrosine value increases with increase in storage period irrespective of packaging material used.

2.8 PROXIMATE COMPOSITION

2.8.1 Percent moisture

Singh *et al*. (2001) reported an inverse relationship between moisture content of chicken meat and protein content of chicken meat during the preparation of intermediate moisture meats.

Tshabalala *et al*. (2003) evaluated the meat quality of designated South African indigenous sheep and goat breeds and revealed that the soft tissue fat and muscle of goat contained more moisture than sheep.

Sen *et al*. (2004) experimented on carcass yield composition and meat quality attributes of sheep and goat under semiarid conditions and stated that chevon had significantly ($P<0.01$) more moisture than mutton.

Modi *et al*. (2006) reported percent moisture level of 68.4% in chicken curry and 78.9% in chicken gravy.

Bhat *et al.* (2013a) studied the quality characteristics of microwave cooked chicken seekh kebabs extended with different non-meat proteins and observed a significant ($P<0.05$) decrease in moisture content over the period of storage.

Pandey *et al.* (2014) investigated on physico-chemical and textural properties of shami kebab prepared by deep fat frying and grilling at varied time and temperature of processing and reported more ($P<0.05$) moisture loss in deep fat fried shami kebab than grilled kebab.

Lijalem *et al*. (2015) studied the quality of beef, chevon and mutton at Hawassa (south ethopia) and revealed that the raw meat samples had higher moisture percent when compared to cooked meat.

Martina (2017) studied the effect of incorporation of whole egg liquid on physico-chemical and sensory parameters of chicken cutlets with its control and stated that moisture content increases with increase in level of whole egg liquid and it was significantly ($p<0.05$) higher in cutlets with 7.5% whole egg liquid than that of control this might be due to higher moisture retention and water binding property of egg albumen.

Okushanova *et al*. (2017) studied the water binding capacity, pH, chemical composition and micro structure of livestock meat and poultry and revealed that goat meat had significant ($P<0.05$) higher moisture than lamb meat.

Mohammed *et al.* (2020) compared raw camel meat with beef, mutton and chicken and stated that moisture content differed significantly ($P<0.05$) among different species and found that the moisture content of beef, mutton and chicken was slightly changed after storage period of one week.

2.8.2 Percent protein

Ayanwale *et al.* (2007) reported percent crude protein content on dry basis in fresh chicken, oven dried chicken and sundried chicken as 64.38%, 75.53% and 77.99% respectively.

Mushi *et al*. (2008) studied the suitability of Norwegain short tail lambs, Norwegain dairy goats and Cashmere goats for meat production and found that the chemical analysis of boneless loin slices showed that lamb had 13% higher fat content and 9% lower moisture and 4% lower protein than goat meat.

Kandeepan *et al*. (2009) evaluated buffalo meat from young male, spent male, spent female groups to develop ready to eat keema which was stored at ambient and refrigeration temperature and found that protein content of keema from spent male buffalo meat was significantly ($P<0.05$) greater than other groups.

Bhat *et al.* (2013a) studied the quality characteristics of microwave cooked chicken seekh kebabs extended with different non-meat proteins and observed a non-significant ($P>0.05$) increase in protein content over the period of storage.

Mursheda *et al*. (2014) compared the carcass and meat quality of black bengal goat and indigenous sheep of Bangladesh and revealed no significant difference in crude protein values between sheep and goat.

Martina (2017) studied the effect of incorporation of whole egg liquid on physico-chemical and sensory parameters of chicken cutlets with its control and stated that protein percentage of control product was significantly ($p<0.05$) higher than cutlets prepared with incorporation of whole egg liquid this might be due to lower protein content of whole egg liquid as compared to chicken meat.

Mohammed *et al.* (2020) compared raw camel meat with beef, mutton and chicken and stated that there was a slight difference in protein content between camel and meat from other species and found that the protein was significantly ($P<0.05$) decreased in chicken as compared with other meat species.

2.8.3 Percent fat

Santos *et al*. (2008) studied on carcass composition and meat quality of equally mature kids and lambs and revealed that kid meat had significantly ($P<0.05$) lower fat than lamb.

Bhat *et al.* (2013a) studied the quality characteristics of microwave cooked chicken seekh kebabs extended with different non-meat proteins and observed a significant ($P<0.05$) increase in fat content over the period of storage.

Sunil kumar *et al.* (2013) recorded the fat content of the desi chicken in and around Hyderabad as 1.65%.

Martina (2017) studied the effect of incorporation whole egg liquid on physico-chemical and sensory parameters of chicken cutlets with its control and stated that there was a gradual increase in fat percentage of cutlets prepared with different levels of whole egg liquid and it was significantly ($p<0.05$) higher in cutlets prepared with 7.5% level than that of control this might be due to higher fat content of whole egg liquid as compared to chicken meat.

Mohammed *et al.* (2020) compared raw camel meat with beef, mutton and chicken and stated that fat content differed significantly among different species and found that the fat content decreased during the storage period of one week and also observed that there was a large change and high decrease in crude fat of beef and mutton.

2.8.4 Total ash

Bhat *et al.* (2013a) studied the quality characteristics of microwave cooked chicken seekh kebabs extended with different non-meat proteins and observed a significant ($P<0.05$) increase in ash content with addition of non- meat proteins.

Shija *et al*. (2013) evaluated the chemical composition and meat quality attributes of indigenous sheep and goats from traditional production systems in Tanzania and stated that no significant difference in ash content sheep and goat carcass.

Lijalem *et al*. (2015) studied the quality of beef, chevon and mutton at Hawassa (south ethopia) and revealed that the raw meat samples had higher ash percent when compared to cooked meat.

Martina (2017) studied the effect of incorporation whole egg liquid on physic-chemical and sensory parameters of chicken cutlets with its control and stated that the ash percentage increases significantly ($p<0.05$) with different levels of whole egg liquid than control and this might be due to higher mineral content of whole egg liquid as compared to chicken meat.

Okushanova *et al*. (2017) studied the water binding capacity, pH, chemical composition and micro structure of livestock meat and poultry and revealed that goat meat had significantly higher ash content ($P<0.05$) than lamb meat.

Alamin *et al*. (2019) assessed the moisture and ash content in meats of cattle sheep, camel and goat in khartoum state and revealed that goat meat had highest amount of ash compared to sheep meat.

Mohammed *et al.* (2020) compared raw camel meat with beef, mutton and chicken and stated that ash content of beef was significantly ($P<0.05$) higher than other species and also found that the ash content of chicken was significantly ($P<0.05$) higher than other species after one week of storage period.

2.9 MICROBIOLOGICAL EXAMINATION

Vazgecer *et al.* (2004) studied microbiological and chemical qualities of chicken doner kebab retailed on the turkish restaurants which resulted in the isolation of pathogenic, potentially pathogenic and spoilage organisms.

Bhat *et al.* (2013a) studied the quality characteristics of microwave cooked chicken seekh kebabs extended with different non-meat proteins and observed that total plate and psychrophilic count increased significantly ($P<0.05$) whereas coliforms were not detected throughout the period of storage.

Bingol *et al.* (2013) stated that the microbial growth in doner kebab was delayed due to the lack of oxygen in the package, which prevented the increase of lipid oxidation and improved the consumer acceptance.

Singh *et al*. (2015) studied the effect of sorghum bicolour on the quality characteristics of chevon to evaluate the effect of clove oil on the storage quality of aerobically packaged chevon cutlets and stated that total plate count (cfu/g) and psychrophilic count (cfu/g) showed a significant increasing trend with the increasing days of storage.

Talukder *et al*. (2015) studied the development and quality characterization of mutton snack and found that the total plate and yeast and mould showed a gradual significant ($P<0.05$) increasing trend throughout the storage period at room temperature.

Biswas *et al.* (2017) worked on the chemical, microbiological and sensory changes of poultry and fish (*Wallago attu)* muscle in refrigerated storage (4 ± 1°C) and found that the total plate count increased significantly ($p<0.05$) throughout the storage and yeast and mould counts were not detected up to 3^{rd} of storage in fish meat and 7th day of storage in poultry meat.

Martina (2017) studied the effect of incorporation whole egg liquid on physic-chemical and sensory parameters of aerobically packaged chicken cutlets with its control stored at refrigeration temperature (4±1°C) and noted no growth of yeast and mould on 0^{th} day and increased there after significantly ($p<0.05$) with increase in the period up to 9 days.

Bonilauri *et al*. (2018) evaluated the effectiveness of traditional cooking process of doner kebab which are raw, sliced cooked portions were officially sampled in kebab houses and in local industrial kebab producer in Reggio Emilia and stated that raw kebabs showed a higher number of aerobic bacteria range 4.04-8.86 log CFU/g that was not completely destroyed in cooked sliced kebab.

Khan *et al.* (2018) focused on the shelf-life enhancement of the ready-to-eat buffalo meat curry at ambient temperature and refrigerated storage condition. The quality of the products were evaluated by studying the microbiological characteristics including total plate count (TPC), yeast and mould (YMC) count and explored that the treated products were acceptable up to 5 days of storage.

Rajaei *et al.* (2021) investigated the prevalence and antimicrobial resistance of common food borne pathogens in raw kebab and hamburger samples collected from fast food centers and restaurants and stated that the mean value of total bacterial count in raw kebabs and hamburger samples was 6.72±0.68 log CFU/g and 6.64±0.66 log CFU/g respectively.

2.10 SENSORY EVALUATION

Huang and Ho (2001) reported that meat flavour constituents are formed from the heat degradation of compounds such as fats, proteins and carbohydrates and thermal processes.

Kumar and Sharma (2004) reported that low ground pork patties could be safely stored at refrigeration temperature (4± 1 °C) in air permissible film for 21 days without affecting it their sensory quality.

Tornberg (2005) discussed the structural changes on cooking in whole meat and comminuted meat products, and the alterations in water-holding and texture of the meat product.

Chidanandaiah and Keshri (2006) observed reduction in scores of all the sensory attributes viz., appearance, juiciness, flavour, texture and overall palatability of pectin coated buffalo meat patties with the progress of storage period.

Dwivedi *et al*. (2006) investigated the effect of antioxidant and sensory characteristics of cinnamon, cloves, fennel, pepper, and star anise (Chinese 5- spice ingredients) in cooked ground beef, and reported a high correlation between TBA values and panel scores for rancid odour and flavour and spice flavour was inversely correlated with rancid odour and flavour.

Naveena *et al.* (2006) observed declining scores for all the sensory attributes during storage of chicken patties formulated with ragi flour.

Kumar *et al.* (2007) observed that the appearance, juiciness and texture scores of chicken patties added with 5% sorghum flour, 10% barley flour and 5% pressed rice flour were comparable throughout storage period of 28 day. Thereafter, significant decline in flavour and overall acceptability scores were noticed.

Kala *et al.* (2007) reported that the sensory quality of chicken patties did not differ significantly during refrigerated storage and the product remained acceptable up to 9 days.

Devalakshmi *et al.* (2010) studied the physico-chemical, sensory and microbial quality of chicken meat chips and suggested that the chicken meat chips prepared with formulations extended with 15% black gram flour and 15% bengal gram flour of partially cooked meat were more acceptable up to 8 weeks at both ambient (37 ± 2°C) and refrigeration (7 ± 1°C) storage.

Indumathi *et al*. (2011) reported an improvement in mean juiciness and overall acceptability scores of low-fat chevon patties by addition of sodium alginate (SA).

Kandeepan *et al.* (2011) reported the overall acceptability of buffalo meat curry decreased significantly during 3 days at ambient storage compared to refrigerated storage.

Andres-Bello *et al.* (2013) discussed that the colour and texture are important quality characteristics and major factors affecting sensory perception and consumer acceptance of foods.

Panozzo *et al.* (2015) studied the nutritional value and energy content of the ready to eat food and stated that the nutritional quality of kebabs was mainly influenced by the abundance of meat used in preparation of product.

Biswas *et al.* (2017) investigated the chemical, microbiological and sensory changes of poultry and fish (*Wallago attu*) muscle in refrigerated storage (4 ± 1°C) and concluded that both the meats were accepted up to 7 days as per sensory analysis and the upper limit of safety optima was up to 10th day of refrigerated storage period as per chemical and microbiological quality basis.

Martina (2017) studied the effect of incorporation of whole egg liquid on physico-chemical and sensory parameters of aerobically packaged chicken cutlets with its control and stated that the mean sensory scores of chicken cutlets at different levels of whole egg liquid did not differ significantly ($p>0.05$) as compared to control and showed a gradual decrease for all parameters with increase in storage period of 9 days at refrigeration temperature (4±1°C).

Chapter – III

MATERIALS AND METHODS

CHAPTER III

MATERIALS AND METHODS

In the present research, an attempt has been made to standardize the formulation and processing conditions for development of shikampuri kebabs by using liquid egg as binder. In the first phase, trials were conducted to optimize the level of incorporation of egg albumen, egg yolk and whole egg, separately from three different levels (5%, 7.5%, 10%) in the basic formulation of both chicken and mutton shikampuri kebabs. The optimum (10%) level of incorporation of egg albumen, egg yolk and whole egg, separately as binder in the shikampuri kebab was adjudged on the basis of sensory evaluation scores. A total of six trials were performed to develop and standardize both chicken and mutton shikampuri kebabs incorporated with liquid egg as binder (10%) and bengal gram dal as non meat protein (20%). During the second phase, the selected better formulations of shikampuri kebabs in the first phase were subjected to refrigerated (4 ± 1^0C) storage till spoilage and the product was evaluated for its quality at regular intervals of 0, 3, 6, 9 and 12th day.

3.1 LOCATION

The present study was conducted in the Department of Livestock Products Technology, N.T.R College of Veterinary Science, Gannavaram.

3.2 RAW MATERIALS

3.2.1 Chicken

Broilers of 6 weeks of age were purchased from local market of Gannavaram. They were slaughtered by using halal method in the Department of Livestock Products Technology. The body fat was trimmed and deboning of dressed chicken was done manually removing all tendons and separable connective tissue. The meat was packaged in poly ethylene bags and kept at refrigeration temperature (4±1 °C) before use.

3.2.2 Mutton

Sheep that was slaughtered by using halal method has purchased from the local market of Gannavaram. Which was free from bones and fat and that meat was washed and packed in poly ethylene bags and kept at refrigeration temperature (4±1 °C) before use.

3.2.3 Eggs

Fresh eggs which are clean, free from dirt and dust were purchased from the local market. Care was taken to obtain non soiled eggs with no cracks.

3.2.4 Bengal gram dal

It was purchased from the local market, washed thoroughly and soaked for 30 minutes.

3.2.5 Curd

Freshly prepared curd was purchased from the Vijaya Dairy (Andhra Pradesh Dairy Development Cooperation Federation Ltd.) in the local market.

3.2.6 Salt

Commercial brand of salt (NaCl) *viz.* Tata salt was procured from local market.

3.2.7 Condiments

Fresh condiments such as ginger (*Zingiber officinale*) and garlic (*Allium sativum*) in the ratio of 1:1 were used in this study. The external covers of ginger and garlic were peeled off, washed thoroughly under running tap water and made into small pieces. Then chopped by using mortar and pestle and was utilized as per the composition of mix, presented in table.

3.2.8 Spice mix contents

Spice substances viz. cloves, cinnamon, cardamom, black pepper and caraway seeds were dried in hot air oven at 50±1^{0}C for 2 hours and made into powder by using mortar and pestle. The composition of spice mix was presented in Table 1.

Table 1: Composition of spice mix substances used in the study.

INGREDIENTS	PERCENTAGE
Cloves	0.06
Cinnamon	0.12
Cardamom	0.12
Black pepper	0.06
Caraway seeds	1.20

3.2.9 Chemicals and media

All chemicals (pH 4 and pH 7 tablets), hydrochloric acid, acetic acid, TBA reagent, ether, TCA reagent, tyrosine, sodium hydroxide, folin and ciocalteu's phenol, peptone water, tartaric acid solution, plate count agar and potato dextrose agar have been procured from Himedia laboratories Pvt.Ltd, Mumbai.

3.3 PHASE I

3.3.1 Method of Preparation of shikampuri kebab with chicken meat

The chicken meat pieces were washed thoroughly and split chickpeas (bengal gram dal) were washed and soaked for 30 minutes before starting the preparation. The weighed meat pieces were added in the pressure cooker, then 200ml of water, soaked bengal gram dal, crushed cardamom, cinnamon stick, cloves, black pepper, shahi jeera, salt, red chili powder, turmeric powder, chopped ginger and garlic were added according to the formulation. They were mixed thoroughly, then covered with the lid and cooked for 15 to 20 minutes for chicken till the meat is cooked and the dal is soft. This was allowed to cool for 10 minutes, after that added only egg albumen/ only yolk/ whole egg followed by grinding in food processor for 5 to 10 minutes to get the desired batter.

3.3.2 Method of Preparation of shikampuri kebab with mutton

The mutton pieces were washed thoroughly and split chickpeas (bengal gram dal) were washed and soaked for 30 minutes before starting the preparation. The weighed meat pieces were added in the pressure cooker, then 200 ml of water, soaked bengal gram dal, crushed cardamom, cinnamon stick, cloves, black pepper, shahi jeera, salt, red chili powder, turmeric powder, chopped ginger and garlic were added according to the formulation. They were mixed thoroughly, then covered with the lid and cooked for 30 to 45 minutes till the meat is cooked and the dal is soft. This was allowed to cool for 10 minutes, after that added only egg albumen/ only yolk/ whole egg followed by grinding in food processor for 5 to 10 minutes to get the desired batter.

3.3.3 Preparation of ingredients for filling

Meanwhile curd was taken in to the clean dry muslin cloth and squeezed to remove the moisture from the curd to get hung curd it was weighed and then transferred in to the bowl. Onions, chillies, coriander leaves, mint leaves were thoroughly washed and chopped separately and then these were taken and the filling was prepared by mixing with the hung curd, salt and lemon juice according to the formulation.

Table 2: Formulation of shikampuri kebabs from chicken

Ingredients	Grams
Chicken Meat	500
Bengal gram dal	100
Whole egg	50
Red Chilli powder	12

Turmeric Powder	1.5
Ginger and Garlic (finely chopped)	20
Cinnamon	0.6
Green cardamom	0.6
Cloves	0.3
Black pepper	0.3
Shahi Jeera	6
Salt	10
Water	200 (ml)
Oil	For shallow fry

Table 3: Formulation of shikampuri kebabs from mutton

Ingredients	Grams
Mutton	500
Bengal gram dal	100
Whole egg	50
Red Chilli powder	12
Turmeric Powder	1.5
Ginger and Garlic (finely chopped)	20
Cinnamon	0.6
Green cardamom	0.6
Cloves	0.3
Black pepper	0.3
Shahi Jeera	6
Salt	10
Water	200 (ml)
Oil	For shallow fry

Fig 1: Flow chart showing the preparation of shikampuri kebabs with chicken

Boneless chicken pieces taken in pressure cooker

↓

Addition of water 200 ml

↓

Addition of soaked bengal gram dal

↓

Addition of salt, spice mix

↓

Addition of red chilli powder, turmeric powder

↓

Addition of finely chopped ginger and garlic

↓

Pressure cooking for 15 to 20 minutes, 15 psi

↓

Allowed to cool for 10 minutes

↓

Addition of only egg albumen/ only yolk/ whole egg

↓

Blending in food processor for 5 to 10 minutes

↓

Kebab mixture

(Preparation of kebab mixture)

↓

Preparing the filling by mixing the hung curd with finely chopped onions, chillies, coriander leaves, mint Leaves, salt and lemon juice.

↓

Taken the lemon size ball of the kebab mixture and flatten in between the palms like a disc

↓

Place a small filling of the hung curd and covered from all sides and again flatten it into a shape of disc

↓

Shallow frying in hot oil till golden brown on medium heat

↓

Transfer the kebab on kitchen napkin to soak excess oil.

↓

Packaging

↓

Shikampuri kebab

Fig 2: Flow chart showing the preparation of shikampuri kebabs with mutton

Boneless mutton pieces taken in pressure cooker

↓

Addition of water 200 ml

↓

Addition of soaked bengal gram dal

↓

Addition of salt, spice mix

↓

Addition of red chilli powder, turmeric powder

↓

Addition of finely chopped ginger and garlic

↓

Pressure cooking for 30 to 45 minutes, 15 psi

↓

Allowed to cool for 10 minutes

↓

Addition of only egg albumen/only egg yolk/whole egg

↓

Blending in food processor for 5 to 10 minutes

↓

Kebab mixture

(Preparation of kebab mixture)

↓

Preparing the filing by mixing the hung curd with finely chopped onions, chillies, coriander leaves, mint leaves, salt and lemon juice.

↓

Taken the lemon size ball of the kebab mix and flatten in between the palms like a disc

↓

Place a small filling of the hung curd and covered from all sides and again flatten it into a shape of disc

↓

Shallow frying in hot oil till golden brown on medium heat

↓

Transfer the kebab on kitchen napkin to soak excess oil.

↓

Packaging

↓

Shikampuri kebab

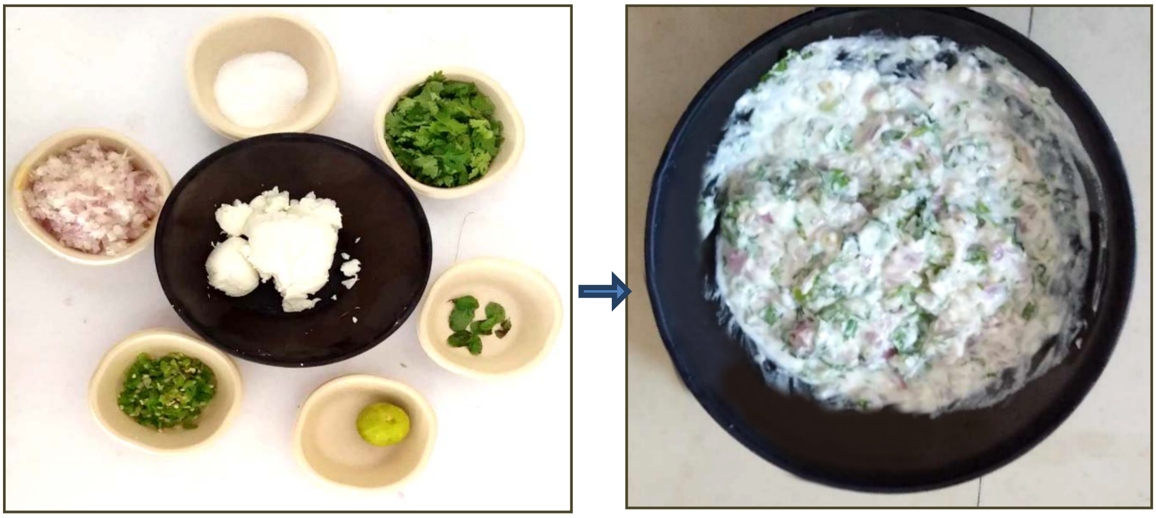


Plate 1: Ingredients that are used for filling (Hung curd, lemon, chopped chillies, onions, coriander, mint leaves and salt

Plate 2: The picture showing stuffing in the center of the shikampuri kebab

Plate 3: Control chicken shikampuri kebabs

Plate 4: Chicken shikampuri kebabs with liquid egg albumen

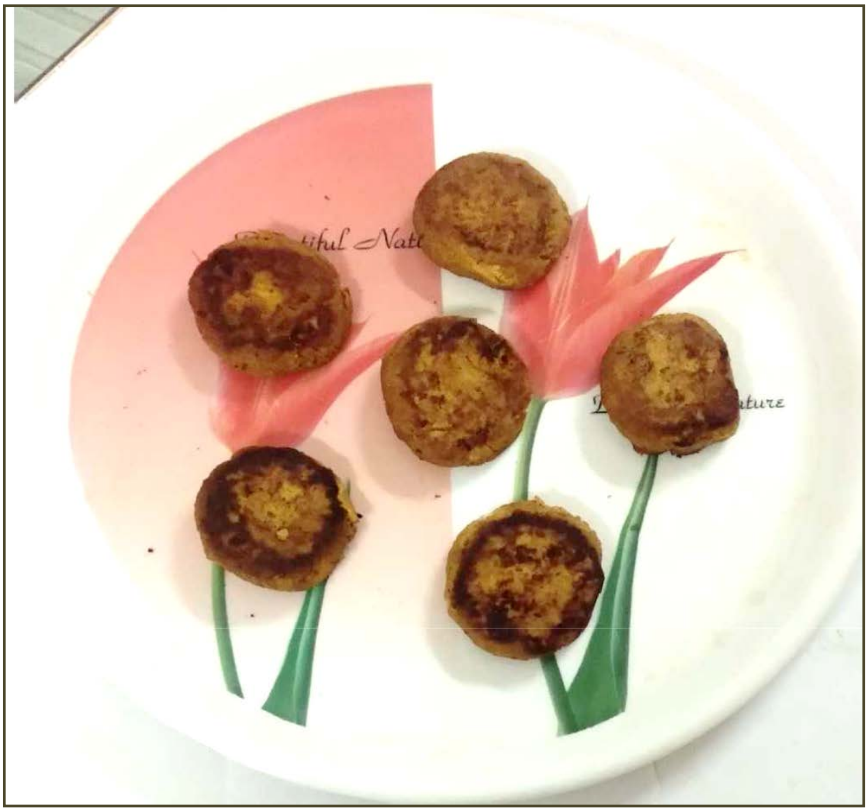


Plate 5: Chicken shikampuri kebabs with liquid egg yolk

Plate 6: Chicken shikampuri kebabs with liquid whole egg

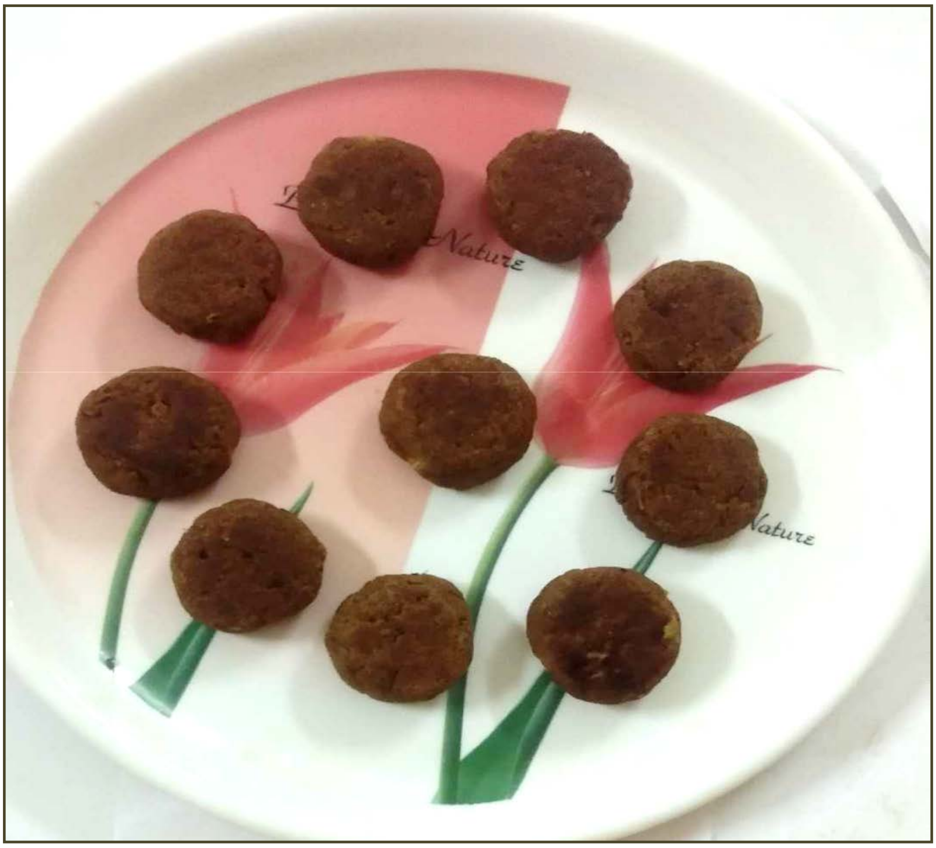


Plate 7: Control mutton shikampuri kebabs

Plate 8: Mutton shikampuri kebabs with liquid egg albumen

Plate 9: Mutton shikampuri kebabs with liquid egg yolk

Plate 10: Mutton shikampuri kebabs with liquid whole egg

Table 4: Standardization of ingredients for preparation of both chicken and mutton shikampuri kebabs

Ingredients	Treatments	
	Chicken	Mutton
Control (%)	C1	C2
Egg albumen (10%)	T1	T4
Egg Yolk (10%)	T2	T5
Whole Egg (10%)	T3	T6

3.4 ANALYSIS

Shikampuri kebabs were analysed for physico-chemical characteristics microbiological and sensory evaluation.

3.5 PHYSICO-CHEMICAL CHARACTERISTICS

The eight different formulations thus developed were subjected to analysis in terms of following parameters.

3.5.1 pH

pH of the preparation was estimated by using the method of Troutt *et al.* (1992) using digital pH meter (Oakton Instruments, USA).

Five grams of sample was homogenized with 45 ml of distilled water in a laboratory blender for about one minute. The pH was recorded by immersing the combined glass electrode of digital pH meter in the homogenate. The pH meter was calibrated with buffer solutions of pH 4 and 7 as per user guide instructions prior to measurement.

3.5.2 Cooking yield (%)

Cooking yield per cent was determined by calculating the difference in weight of the shikampuri kebabs before and after frying.

$$\boldsymbol{Cookingyield}\ (\%) = \frac{\textbf{weight after frying}}{\textbf{weight before frying}} \times \mathbf{100}$$

3.6 PROXIMATE COMPOSITION

Proximate composition was determined by following the standard methods of AOAC (2019).

3.7 ORGANOLEPTIC EVALUATION

The shikampuri kebabs thus prepared as per the formulations were subjected to a 6 members semi-trained taste panel to evaluate appearance, flavour, texture, juiciness, meat intensity flavour and overall acceptability on a 9 point hedonic scale. (where, 9 = can't think of no improvement, 1 = extremely undesirable) as prescribed by Keeton, (1983) with slight modifications as indicated in Annexure-II. Sensory evaluation was conducted between 3.30 PM to 4.00 PM and potable water was provided to the panelists for rinsing their mouth in between evaluation of different samples.

3.8 PHASE-II

During the second phase, the above formulations of both chicken and mutton shikampuri kebabs along with control were subjected to refrigerated (4±1ºC) storage till spoilage and the product was evaluated for its quality at regular intervals of 0, 3, 6, 9 and 12th days with the following parameters.

3.8.1 Physico-Chemicalcharacteristics

3.8.1.1 pH

pH of the shikampuri kebabs was determined according to the Method as described in 3.5.1.

3.8.1.2 Batter stability (%)

Batter stability was determined by the procedure of Kondaiah *et al.,* (1985). About 25 g meat batter was taken in low density polyehthylene bags and heated in a thermostatically controlled water bath at 80°C for 20 min. Then the exudate was drained out and dried with tissue paper and the cooked mass was weighed. The percentage of cooked mass was expressed as batter stability.

3.8.1.3 Thiobarbituric acid reactive substances (TBARS) value

2-TBARS values were determined by the method of Tarladgis *et al*. (1960). 10g of sample was blended with 50ml of distilled water in a waring blender for 2 minutes. This mixture was transferred to a 500ml Kjeldahl flask quantitatively. Then the blender was rinsed with 45 ml of distilled water and was transferred quantitatively to the flask to which 5 ml of HCl was added previously. Few glass beads were added to the contents to avoid frothing and bumping. The contents of the flask were heated to 80-100ºC with the help of a heating mantle and 50ml of distillate was collected in a stoppered measuring cylinder. 5ml of thoroughly mixed distillate was pipetted out in duplicates into 20 ml glass stoppered test tubes to which 5 ml of 0.02 M TBA reagent was added. The contents were mixed well and heated in a boiling water bath for 35 minutes. A blank consisting of 5 ml of distilled water and 5 ml TBA reagent was run simultaneously. After cooling the tubes under running water, optical density (OD) was measured in a spectrophotometer at 532 nm.

$$\boldsymbol{TBARS\ value\ (mg\ of\ malonaldehyde\ per\ kg\ of\ sample) = OD \times 7.8}$$

Where, OD – Optical Density at 532 nm.

3.8.1.4 Tyrosine value (mg)

Tyrosine value was estimated adopting the procedure of Strange *et al.* (1977). 2 g of the kebab sample was weighed and homogenized with 10 ml of 20% TCA for 2 min. The homogenate was allowed to stand for 10 minutes and then filtered using Whatman No.42 filter paper. 2.5 ml of the filtrate was pipetted out to a test tube and 2.5 ml of distilled water and 10 ml of freshly prepared 0.5N NaOH were added to it. The tubes were mixed and were allowed to stand for 10 minutes. This was then followed by the addition of 3 ml of Folin Ciocalteau's reagent (1:2 in distilled water) and the tubes were mixed well and kept in dark for color development. O.D was read after 30 min at 730 nm using a spectrophotometer. Tyrosine value was calculated by referring to the standard curve of tyrosine and expressed as mg tyrosine / 100g of product.

3.8.1.4.1 Standard graph for estimation of tyrosine value

One hundred mg of tyrosine was dissolved in 500 ml of 5 per cent Trichloro acetic acid in a volumetric flask. The following volumes of the above tyrosine solution were then transferred to a series of 100 ml volumetric flasks: 0, 1, 3, 5, 7, 10, 12, 15, 20, 25, 35, 40, 45 and 50 ml. They were made up to the mark with distilled water and mixed thoroughly. Ten ml of 0.5 N NaOH and 3 ml of diluted Folin and Ciocalteu's phenol reagent was added to 5 ml of each of the tyrosine solution and was mixed thoroughly and then treated as described for tyrosine value. The standard graph was prepared with known concentration of tyrosine in the solutions and their corresponding absorbance values following the least square method.

3.8.2 Microbial Quality

The microbial quality of preparation was evaluated by estimating the Total plate count (TPC) and Yeast and Mold counts (YMC) following pour plating technique as per standard procedure of ICMSF (1980).

3.8.2.1 Preparation of serial dilution

For microbiological analysis, 5g of representative sample was homogenized with 45ml of 0.1 per cent sterile peptone water in laboratory blender and tenfold serial dilutions were made from each sample by using 0.1 per cent peptone water as diluent.

3.8.2.2 Total plate count

Sterile petri plates were inoculated aseptically with 1ml sample from appropriate dilution in duplicates. 15-20 ml of sterilized and plate count agar (Himedia, Mumbai) at 44-46^{0}C was poured into petri plates gently and the contents were mixed well for even distribution of the sample without air bubbles and plates were allowed for some time to solidify. The plates were then incubated in inverted positions at 37°C for 24 – 48 hrs. Plates having 25-250 colonies were selected and the colonies were counted. The results were expressed as log cfu per gram of the sample.

3.8.2.3 Yeast and mold count

The yeast and mold count were determined by pour plate technique using Potato dextrose agar (PDA). Inoculated plates were incubated at 23-25°C for 5-7days. Colonies were counted and expressed as log cfu per gram of the sample.

3.8.3 Organoleptic Evaluation

Organoleptic evaluation of the shikampuri kebabs as samples was carried out as per the procedure outlined in 3.7.

3.9 STATISTICAL ANALYSIS

The data thus obtained was subjected to statistical analysis using SPSS MAC, version 20.0, SPSS Chicago (US).

Chapter – IV

RESULTS

CHAPTER IV

RESULTS

The trials were conducted to determine the optimum level of incorporation of egg albumen, egg yolk and whole egg, separately as binder in the formulation of shikampuri kebab. Different formulations were prepared by incorporating egg albumen, egg yolk and whole egg, separately at three different levels (5%, 7.5%, 10%) in the basic formulation of shikampuri kebab. The mean ± SE sensory scores of the developed products were presented in table 5.

4.1 SENSORY SCORES OF SHIKAMPURI KEBAB WITH CHICKEN

4.1.1 Appearance

The overall mean ± SE values of appearance of chicken shikampuri kebab with egg albumen prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 6. The mean ± SE values of appearance of control, 5%, 7.5% and 10% were 5.83 ± 0.24, 6.25 ± 0.11, 6.58 ± 0.15 and 7.50 ± 0.12, respectively. The mean values of treatments 7.5%, 10% were significantly ($p<0.05$) higher and the treatment 5% remains comparable with the control and 10% was significantly higher ($p<0.05$) among the treatments regarding the appearance of the chicken shikampuri kebabs.

The overall mean ± SE values of appearance of chicken shikampuri kebab with egg yolk prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 7. The mean ± SE values of appearance of control, 5%, 7.5% and 10% were 5.83 ± 0.24, 6.25 ± 0.28, 7.41 ± 0.15 and 7.66 ± 0.10, respectively. The mean values of treatments 7.5%, 10% were significantly ($p<0.05$) higher and the treatment 5% remains comparable with the control, 7.5% and 10% remains comparable among the treatments regarding the appearance of the chicken shikampuri kebabs.

The overall mean ± SE values of appearance of chicken shikampuri kebab with whole egg prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 8. The mean ± SE values of appearance of control, 5%, 7.5% and 10% were 5.83 ± 0.24, 6.33 ± 0.10, 7.50 ± 0.12 and 7.83 ± 0.21, respectively. The mean values of treatments 7.5%, 10% were significantly ($p<0.05$) higher and the treatment 5% remains comparable with the control, 7.5% and 10% remains comparable among the treatments regarding the appearance of the chicken shikampuri kebabs.

4.1.2 Flavour

The overall mean ± SE values of flavour of chicken shikampuri kebab with egg albumen prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 6. The mean ± SE values of flavour of control, 5%, 7.5% and 10% were 5.91 ± 0.27, 6.33 ± 0.10, 6.75 ± 0.17 and 7.83 ± 0.16, respectively. The mean values of treatments 7.5%, 10% were significantly ($p<0.05$) higher and the treatment 5% remains comparable with the control and 10% was significantly higher ($p<0.05$) among the treatments whereas 5% and 7.5% remains comparable regarding the flavour of the chicken shikampuri kebabs.

The overall mean ± SE values of flavour of chicken shikampuri kebab with egg yolk prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 7. The mean ± SE values of flavour of C, 5%, 7.5% and 10% were 5.91 ± 0.27, 6.16 ± 0.21, 7.41 ± 0.15 and 7.91 ±

0.20, respectively. The mean values of treatment 10% was significantly ($p<0.05$) higher and the treatments 5% remains comparable with the control and 10% level was significantly ($p<0.05$) better among all the treatments regarding the flavour of the chicken shikampuri kebabs.

The overall mean ± SE values of flavour of chicken shikampuri kebab with whole egg prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 8. The mean ± SE values of flavour of control, 5%, 7.5% and 10% were 5.91 ± 0.27, 6.25 ± 0.11, 7.41 ± 0.15 and 8.08 ± 0.27, respectively. The mean values of treatments 7.5%, 10% were significantly ($p<0.05$) higher and the treatment 5% remains comparable with the control, 10% level was significantly ($p<0.05$) better among all the treatments regarding the flavour of the chicken shikampuri kebabs.

4.1.3 Texture

The overall mean ± SE values of texture of chicken shikampuri kebab with egg albumen prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 6. The mean ± SE values of texture of control, 5%, 7.5% and 10% were 5.75 ± 0.27, 6.50 ± 0.27, 6.91 ± 0.27 and 7.66 ± 0.27, respectively. The mean values of treatment 5% remains comparable with the control and 10% was significantly better ($p<0.05$) than the 5% and 7.5% regarding the texture of the chicken shikampuri kebabs.

The overall mean ± SE values of texture of chicken shikampuri kebab with egg yolk prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 7. The mean ± SE values of texture of control, 5%, 7.5% and 10% were 5.75 ± 0.27, 6.58 ± 0.15, 7.0 ± 0.18 and

7.83 ± 0.24, respectively. The mean values of treatments 5% and 7.5%, were comparable with the control, 10% was significantly higher ($p<0.05$) among the treatments regarding the texture of the chicken shikampuri kebabs.

The overall mean ± SE values of texture of chicken shikampuri kebab with whole egg prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 8. The mean ± SE values of texture of control, 5%, 7.5% and 10% were 5.75 ± 0.27, 6.66 ± 0.16, 7.16 ± 0.16 and 7.91 ± 0.20, respectively. The mean values of treatments 5% and 7.5%, were comparable with the control, 10% was significantly higher ($p<0.05$) among the treatments regarding the texture of the chicken shikampuri kebabs.

4.1.4 Juiciness

The overall mean ± SE values of juiciness of chicken shikampuri kebab with egg albumen prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 6. The mean ± SE values of juiciness of control, 5%, 7.5% and 10% were 5.00 ± 1.00, 6.66 ± 0.16, 7.16 ± 0.16, 7.91 ± 0.20, respectively. The mean values of all the treatments 5%, 7.5% and 10% were significantly ($p<0.05$) higher than the control and 10% was significantly higher ($p<0.05$) among the treatments regarding the juiciness of the chicken shikampuri kebabs.

The overall mean ± SE values of juiciness of chicken shikampuri kebab with egg yolk prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 7. The mean ± SE values of juiciness of control, 5%, 7.5% and 10% were 5.00 ± 1.00, 6.58 ± 0.23, 7.08 ± 0.15 and 7.16 ± 0.16, respectively. The mean values of the treatments 5%, 7.5% remains comparable with control and 10% was non significantly higher ($p<0.05$) than 7.5% regarding the juiciness of the chicken shikampuri kebabs.

The overall mean ± SE values of juiciness of chicken shikampuri kebab with whole egg prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 8. The mean ± SE values of juiciness of control, 5%, 7.5% and 10% were 5.00 ± 1.00, 6.83 ± 0.24, 7.33 ± 0.10 and 7.58 ± 0.15, respectively. The mean values of the treatments 5% remains comparable with control and 10% was non significantly higher ($p<0.05$) than 7.5% regarding the juiciness of the chicken shikampuri kebabs**.**

4.1.5 Overall Acceptability

The overall mean ± SE values of overall acceptability of chicken shikampuri kebab with egg albumen prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 6. The mean ± SE values of overall acceptability of control, 5%, 7.5% and 10% were 5.75 ± .28, 6.08 ± 0.15, 6.66 ± 0.21 and 7.75 ± 0.21, respectively. The mean values of treatment 5% remains comparable with the control and 10% was significantly higher ($p<0.05$) than the 5% and 7.5% regarding the overall acceptability of the chicken shikampuri kebabs.

The overall mean ± SE values of overall acceptability of chicken shikampuri kebab with egg yolk prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 7. The mean ± SE values of overall acceptability of control, 5%, 7.5% and 10% were 5.75 ± 0.28, 6.33±0.16, 6.91±0.27 and 7.91±0.15, respectively. The mean values of treatment 5% remains comparable with the control and 10% was significantly higher ($p<0.05$) than the 5% and 7.5% regarding the overall acceptability of the chicken shikampuri kebabs.

The overall mean ± SE values of overall acceptability of chicken shikampuri kebab with whole egg prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 5. Analysis of variance of the same was presented in table 8. The mean ± SE values of overall acceptability of control, 5%, 7.5% and 10% were 5.75 ± 0.28, 6.41 ± 0.15, 7.25±0.21 and 8.08 ± 0.20, respectively. The mean values of treatment 5% remains comparable with the control and 10% was significantly higher ($p<0.05$) than the 5% and remains comparable with 7.5% regarding the overall acceptability of the chicken shikampuri kebabs.

Table 5: Mean ± SE of chicken shikampuri kebab containing different levels (5%, 7.5%, 10%) of egg albumen, egg yolk, whole egg

Parameter	Control	Egg albumen			Egg yolk			Whole egg		
		5%	7.5%	10%	5%	7.5%	10%	5%	7.5%	10%
Appearance	5.83±0.24[a]	6.25±0.11[ab]	6.58±0.15[b]	7.50±0.12[c]	6.25±0.28[a]	7.41±0.15[b]	7.66±0.10[b]	6.33±0.10 [a]	7.50±0.12 [b]	7.83±0.21 [b]
Flavour	5.91±0.27[a]	6.33±0.10[ab]	6.75±0.17[b]	7.83±0.16[c]	6.16 ±0.21[a]	7.41±0.15[b]	7.91±0.20[b]	6.25±0.11[a]	7.41±0.15[b]	8.08±0.27[b]
Texture	5.75±0.27[a]	6.50±0.27[ab]	6.91±0.27[bc]	7.66±0.27[c]	6.58±0.15[b]	7.00±0.18[b]	7.83±0.24[c]	6.66±0.16[b]	7.16±0.16[b]	7.91±0.20[c]
Juiciness	5.00±1.00[a]	6.66±0.16[b]	7.16±0.16[b]	7.91±0.20[c]	6.58±0.23[ab]	7.08±0.15[ab]	7.16±0.16[b]	6.83±0.24[ab]	7.33±0.10[b]	7.58±0.15[b]
Over all acceptability	5.75±0.28[a]	6.08±0.15[ab]	6.66±0.21[b]	7.75±0.21[c]	6.33±0.16[ab]	6.91±0.27[b]	7.91±0.15[c]	6.41±0.15[ab]	7.25±0.21[bc]	8.08±0.20[c]

Note: Means bearing common superscripts in each row do not differ significantly (P<0.05).

Table 6: Analysis of Variance of sensory characteristics of chicken shikampuri kebab with liquid egg albumen at three different levels (5%, 7.5%, 10%)

Parameter		SS	df	MS	F
Appearance	Between groups	9.042	3	3.014	17.642**
	Within groups	3.417	20	.171	
	Total	12.458	23		
Flavour	Between groups	12.208	3	4.069	19.150**
	Within groups	4.250	20	.213	
	Total	16.458	23		
Texture	Between groups	11.542	3	3.847	15.650**
	Within groups	4.917	20	.246	
	Total	16.458	23		
juiciness	Between groups	14.875	3	4.958	23.333**
	Within groups	4.250	20	.213	
	Total	19.125	23		
Overall acceptability	Between groups	13.865	3	4.622	15.959**
	Within groups	5.792	20	.290	
	Total	19.656	23		

***Means significant, **Means Highly Significant, NS – Non-Significant**

SS- Sum of squares, MS- Mean square, df- degrees of freedom, F-F ratio

Table 7: Analysis of Variance of sensory characteristics of chicken shikampuri kebab with liquid egg yolk at three different levels (5%, 7.5%, 10%)

Parameter		SS	df	MS	F
Appearance	Between groups	14.208	3	4.736	18.042**
	Within groups	5.250	20	.263	
	Total	19.458	23		
Flavour	Between groups	16.781	3	5.594	20.496**
	Within groups	5.458	20	.273	
	Total	22.240	23		
Texture	Between groups	13.542	3	4.514	18.362**
	Within groups	4.917	20	.246	
	Total	18.458	23		
juiciness	Between groups	18.208	3	6.069	3.597*
	Within groups	33.750	20	1.688	
	Total	51.958	23		
Overall acceptability	Between groups	15.365	3	5.122	16.723**
	Within groups	6.125	20	.306	
	Total	21.490	23		

***Means significant, **Means Highly Significant, NS – Non-Significant**

SS- Sum of squares, MS- Mean square, df- degrees of freedom, F-F ratio

Table 8: Analysis of Variance of sensory characteristics of chicken shikampuri kebab with liquid whole egg at three different levels (5%, 7.5%, 10%)

Parameter		SS	df	MS	F
Appearance	Between groups	16.125	3	5.375	26.875**
	Within groups	4.000	20	.200	
	Total	20.125	23		
Flavour	Between groups	18.333	3	6.111	22.222**
	Within groups	5.500	20	.275	
	Total	23.833	23		
Texture	Between groups	14.875	3	4.958	23.333**
	Within groups	4.250	20	.213	
	Total	19.125	23		
juiciness	Between groups	24.531	3	8.177	4.900*
	Within groups	33.375	20	1.669	
	Total	57.906	23		
Overall acceptability	Between groups	18.458	3	6.153	21.716**
	Within groups	5.667	20	.283	
	Total	24.125	23		

***Means significant, **Means Highly Significant, NS – Non-Significant**

SS- Sum of squares, MS- Mean square, df- degrees of freedom, F-F ratio

4.2 SENSORY SCORES OF SHIKAMPURI KEBAB WITH MUTTON.

4.2.1 Appearance

The overall mean ± SE values of appearance of mutton shikampuri kebab with egg albumen prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 10. The mean ± SE values of appearance of control, 5%, 7.5% and 10% were 5.91 ± 0.27, 6.41 ± 0.15, 6.75 ± 0.17 and7.75 ± 0.17, respectively. The mean values of treatments 7.5%, 10% were significantly ($p<0.05$) higher and the treatment 5% remains comparable with the control and 10% was significantly higher ($p<0.05$) among the treatments where as 5%and 7.5% remains comparable regarding the appearance of the kebabs.

The overall mean ± SE values of appearance of mutton shikampuri kebab with egg yolk prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 11. The mean ± SE values of appearance of control, 5%, 7.5% and 10% were 5.91 ± 0.27, 6.25 ± 0.28, 7.50 ± 0.12 and 7.83 ± 0.16, respectively. The mean values of treatments 7.5%, 10% were significantly ($p<0.05$) higher and the treatment 5% remains comparable with the control, 7.5% and 10% remains comparable among the treatments regarding the appearance of the mutton shikampuri kebabs.

The overall mean ± SE values of appearance of mutton shikampuri kebab with whole egg prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 12. The mean ± SE values of appearance of control, 5%, 7.5% and 10% were 5.91 ± 0.27, 6.33 ± 0.10, 7.66 ± 0.10 and 7.91 ± 0.23, respectively. The mean values of treatments 7.5%, 10% were significantly ($p<0.05$) higher and the treatment 5% remains comparable with the control, 7.5% and 10% remains comparable among the treatments regarding the appearance of the mutton shikampuri kebabs.

4.2.2 Flavour

The overall mean ± SE values of flavour of mutton shikampuri kebab with egg albumen prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 10. The mean ± SE values of flavour of control, 5%, 7.5% and 10% were 5.75 ± 0.21, 6.33 ± 0.10, 7.00 ± 0.22 and 7.83 ± 0.16, respectively. The mean values of treatments 7.5%, 10% were significantly ($p<0.05$) higher and the treatment 5% remains comparable with the control and 10% was significantly higher ($p<0.05$) among the treatments where as 5% and 7.5% remains comparable regarding the flavour of the mutton shikampuri kebabs.

The overall mean ± SE values of flavour of mutton shikampuri kebab with egg yolk prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 11. The mean ± SE values of flavour of control, 5%, 7.5% and 10% were 5.91 ± 0.27, 6.25 ± 0.28, 7.50 ± 0.12 and 7.83 ± 0.16, respectively. The mean values of treatments 7.5%, 10% were significantly ($p<0.05$) higher and the treatment 5% remains comparable with the control, 10% was non significantly ($p<0.05$) higher than 7.5% regarding the flavour of the mutton shikampuri kebabs.

The overall mean ± SE values of flavour of mutton shikampuri kebab with whole egg prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 12. The mean ± SE values of flavour of control, 5%, 7.5% and 10% were 5.91 ± 0.27, 6.25 ± 0.11, 7.41 ± 0.15 and 8.16 ± 0.21, respectively. The mean values of treatments 7.5%, 10% were significantly ($p<0.05$) higher and the treatment 5% remains comparable with the control, 10% was significantly ($p<0.05$) higher among the treatments regarding the flavour of the mutton shikampuri kebabs.

4.2.3 Texture

The overall mean ± SE values of texture of mutton shikampuri kebab with egg albumen prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 10. The mean ± SE values of texture of control, 5%, 7.5% and 10% were 5.91 ± 0.27, 6.41 ± 0.15, 6.75 ± 0.17 and7.75 ± 0.17, respectively. The mean values of treatments 7.5%, 10% were significantly ($p<0.05$) higher and the treatment 5% remains comparable with the control and 10% was significantly higher ($p<0.05$) among the treatments where as 5% and 7.5% remains comparable regarding the texture of the mutton shikampuri kebabs.

The overall mean ± SE values of texture of mutton shikampuri kebab with egg yolk prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 11. The mean ± SE values of texture of control, 5%, 7.5% and 10% were, 5.91 ± 0.27, 6.58 ± 0.15, 7.33 ± 0.21 and 7.91 ± 0.23, respectively. The mean values of all the treatments were significantly higher ($p<0.05$) than the control. 10% was non significantly ($p<0.05$) higher than 7.5% and it remains comparable with 5% regarding the texture of the kebabs.

The overall mean ± SE values of texture of mutton shikampuri kebab with whole egg prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 12. The mean ± SE values of texture of control, 5%, 7.5% and 10% were, 5.91 ± 0.27, 6.66 ± 0.16, 7.33 ± 0.21 and 8.08 ± 0.20, respectively. The mean values of all the treatments were significantly higher ($p<0.05$) than the control. 10% was non significantly ($p<0.05$) higher than 7.5% and it remains comparable with 5% regarding the texture of the kebabs.

4.2.4 Juiciness

The overall mean ± SE values of juiciness of mutton shikampuri kebab with egg albumen prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 10. The mean ± SE values of juiciness of control, 5%, 7.5% and 10% were 5.08 ± 1.02, 6.75 ± 0.21, 7.16 ± 0.16 and 7.91 ± 0.20, respectively. The mean values of treatments 5%, 7.5% remains comparable with the control where as 10% was non significantly ($p<0.05$) higher among the treatments regarding the juiciness of the mutton shikampuri kebabs.

The overall mean ± SE values of juiciness of mutton shikampuri kebab with egg yolk prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 11. The mean ± SE values of juiciness of control, 5%, 7.5% and 10% were 5.08 ± 1.02, 6.58 ± 0.23, 7.08 ± 0.15 and 7.25 ± 0.17, respectively. The mean values of treatments 5%, 7.5% remains comparable with the control whereas 10% was non significantly ($p<0.05$) higher than 7.5% regarding the juiciness of the mutton shikampuri kebabs.

The overall mean ± SE values of juiciness of mutton shikampuri kebab with whole egg prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 12. The mean ± SE values of juiciness of control, 5%, 7.5% and 10% were 5.08 ± 1.02, 6.83 ± 0.24, 7.33 ± 0.10 and 7.66 ± 0.30, respectively. The mean values of the treatments 5% remains comparable with control and 10% was non significantly ($p<0.05$) higher among the treatments regarding the juiciness of the mutton shikampuri kebabs.

4.2.5 Overall Acceptability

The overall mean ± SE values of overall acceptability of mutton shikampuri kebab with egg albumen prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 10. The mean ± SE values of overall acceptability of control, 5%, 7.5% and 10% were 5.83 ± 0.24, 6.08 ± 0.15, 6.66 ± 0.21 and 7.75 ± 0.21, respectively. The mean values of treatment 5% remains comparable with the control and 10% was significantly higher ($p<0.05$) than the 5% and 7.5% regarding the overall acceptability of the kebabs.

The overall mean ± SE values of overall acceptability of mutton shikampuri kebab with egg yolk prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 11. The mean ± SE values of overall acceptability of control, 5%, 7.5% and 10% were 5.83 ± 0.24, 6.33 ± 0.16, 6.91 ± 0.27 and 7.91 ± 0.15, respectively. The mean values of treatment 5% remains comparable with the control and 10% was significantly higher ($p<0.05$) than the 5% and 7.5% regarding the overall acceptability of the kebabs.

The overall mean ± SE values of overall acceptability of mutton shikampuri kebab with whole egg prepared samples of control, 5%, 7.5% and 10% formulations were presented in table 9. Analysis of variance of the same was presented in table 12. The mean ± SE values of overall acceptability of control, 5%, 7.5% and 10% were 5.83 ± 0.24, 6.41 ± 0.15, 7.25± 0.21 and 8.08 ± 0.20, respectively. The mean values of treatments 7.5%, 10% were significantly ($p<0.05$) higher and the treatment 5% remains comparable with the control, 10% was significantly ($p<0.05$) higher among the treatments regarding the overall acceptability of the mutton shikampuri kebabs.

Table 9: Mean ± SE of mutton shikampuri kebab containing different levels (5%, 7.5%, 10%) of egg albumen, egg yolk, whole egg

Parameter	Control	Egg albumen			Egg yolk			Whole egg		
		5%	7.5%	10%	5%	7.5%	10%	5%	7.5%	10%
Appearance	5.91±0.27^{a}	6.41±0.15^{ab}	6.75±0.17^{b}	7.75±0.17^{c}	6.25±0.28^{a}	7.50±0.12^{b}	7.83±0.16^{b}	6.33±0.10^{a}	7.66±0.10^{b}	7.91±0.23^{b}
Flavour	5.75±0.21^{a}	6.33±0.10^{ab}	7.00±0.22^{b}	7.83±0.16^{c}	6.16±0.21^{a}	7.41±0.15^{b}	8.00±0.22^{b}	6.25±0.11^{a}	7.41±0.15^{b}	8.16±0.21^{c}
Texture	5.75±0.21^{a}	6.50±0.18^{ab}	6.91±0.20^{b}	7.83±0.16^{c}	6.58±0.15^{b}	7.33±0.21^{bc}	7.91±0.23^{c}	6.66±0.16^{b}	7.33±0.21^{bc}	8.08±0.20^{c}
Juiciness	5.08±1.02^{a}	6.75±0.21^{ab}	7.16±0.16^{ab}	7.91±0.20^{b}	6.58±0.23^{ab}	7.08±0.15^{ab}	7.25±0.17^{b}	6.83±0.24^{ab}	7.33±0.10^{b}	7.66±0.30^{b}
Over all acceptability	5.83±0.24^{a}	6.08±0.15^{ab}	6.66±0.21^{b}	7.75±0.21^{c}	6.33±0.16^{ab}	6.91±0.27^{b}	7.91±0.15^{c}	6.41±0.15^{a}	7.25±0.21^{b}	8.08±0.20^{c}

Note: Means bearing common superscripts in each row do not differ significantly (P<0.05).

Table 10: Analysis of Variance of sensory characteristics of mutton shikampuri kebab with liquid egg albumen at three different levels (5%, 7.5%, 10%)

Parameter		SS	df	MS	F
Appearance	Between groups	10.792	3	3.597	15.417**
	Within groups	4.667	20	.233	
	Total	15.458	23		
Flavour	Between groups	14.448	3	4.816	23.832**
	Within groups	4.042	20	.202	
	Total	18.490	23		
Texture	Between groups	13.583	3	4.528	20.503**
	Within groups	4.417	20	.221	
	Total	18.000	23		
juiciness	Between groups	25.865	3	8.622	4.909*
	Within groups	35.125	20	1.756	
	Total	60.990	23		
Overall acceptability	Between groups	13.083	3	4.361	16.614**
	Within groups	5.250	20	.263	
	Total	18.333	23		

***Means significant, **Means Highly Significant, NS – Non-Significant**

SS- Sum of squares, MS- Mean square, df- degrees of freedom, F-F ratio

Table 11: Analysis of Variance of sensory characteristics of mutton shikampuri kebab with liquid egg yolk at three different levels (5%, 7.5%, 10%)

Parameter		SS	df	MS	F
Appearance	Between groups	15.708	3	5.236	17.700**
	Within groups	5.917	20	.296	
	Total	21.625	23		
Flavour	Between groups	19.917	3	6.639	27.006**
	Within groups	4.917	20	.246	
	Total	24.833	23		
Texture	Between groups	15.865	3	5.288	20.637**
	Within groups	5.125	20	.256	
	Total	20.990	23		
juiciness	Between groups	17.500	3	5.833	3.333*
	Within groups	35.000	20	1.750	
	Total	52.500	23		
Overall acceptability	Between groups	14.417	3	4.806	17.214**
	Within groups	5.583	20	.279	
	Total	20.000	23		

***Means significant, **Means Highly Significant, NS – Non-Significant**

SS- Sum of squares, MS- Mean square, df- degrees of freedom, F-F ratio

Table 12: Analysis of Variance of sensory characteristics of mutton shikampuri kebab with liquid whole egg at three different levels (5%, 7.5%, 10%)

Parameter		SS	df	MS	F
Appearance	Between groups	17.375	3	5.792	25.273**
	Within groups	4.583	20	.229	
	Total	21.958	23		
Flavour	Between groups	21.698	3	7.233	38.150**
	Within groups	3.792	20	.190	
	Total	25.490	23		
Texture	Between groups	17.708	3	5.903	24.854**
	Within groups	4.750	20	.238	
	Total	22.458	23		
juiciness	Between groups	23.781	3	7.927	4.319*
	Within groups	36.708	20	1.835	
	Total	60.490	23		
Overall acceptability	Between groups	17.365	3	5.788	22.588**
	Within groups	5.125	20	.256	
	Total	22.490	23		

***Means significant, **Means Highly Significant, NS – Non-Significant**

SS- Sum of squares, MS- Mean square, df- degrees of freedom, F-F ratio

Standardization of shikampuri kebab with selected formulations

In the present study, the procedure for preparation of shikampuri kebab with both mutton and chicken meat was standardized by incorporation of liquid egg as binder in different components i.e., egg albumen, egg yolk, whole egg. Among the formulations developed one best formulation from each binder was selected based on physico-chemical and sensory quality and subjected to shelf-life studies under refrigeration (4 ± 1°C) temperature and evaluated at 2 days interval till spoilage. The results obtained for various quality parameters from the study were analysed and presented in detail.

The present chapter describes the results obtained from the different studies carried out during the investigation in accordance with the objectives, following the methods described elsewhere. The results have been presented through narration and supported with suitable tables. Critical analyses as well as comparisons have also been done during the investigation.

Different treatments like chicken without egg was used as control 1, chicken with egg albumen as T1, chicken with egg yolk as T2, chicken with whole egg as T3. and mutton without egg was used as control 2, mutton with egg albumen as T4, mutton with egg yolk as T5, mutton with whole egg as T6.

4.3 PHYSICO-CHEMICAL PARAMETERS

4.3.1 pH

The overall mean ± SE values of pH of C1, T1, T2 and T3 formulations were presented in table 13. Fig 3. Analysis of variance of the same was presented in table 19. The mean ± SE values pH of C1, T1, T2 and T3 were 5.58 ± 0.04, 5.65 ± 0.03, 5.61 ± 0.03 and 5.68 ±0.02, respectively. The treatments were non significantly higher than the control and there was no significant difference ($p<0.05$) found between the treatments regarding the pH of the chicken shikampuri kebabs.

The overall mean ± SE values of pH of C2, T4, T5 and T6 formulations were presented in table 14. Fig 4. Analysis of variance of the same was presented in table 20. The mean ± SE values pH of C2, T4, T5 and T6 were 5.53 ± 0.03, 5.59 ± 0.02, 5.55 ± 0.02 and 5.63 ± 0.01, respectively. The treatments were non significantly higher than the control and there was no significant difference ($p<0.05$) found between the treatments regarding the pH of the mutton shikampuri kebabs.

4.3.2 Cooking Yield (%)

The overall mean ± SE values of cooking yield (%) of C1, T1, T2 and T3 formulations were presented in table 13. Fig 5. Analysis of variance of the same was presented in table 19. The mean ± SE values of cooking yield of C1, T1, T2 and T3 were 85.84 ± 0.17, 86.65 ± 0.23, 86.98 ± 0.22 and 88.00 ± 0.24, respectively. The treatment T1 remains comparable with C1. T3 was significantly ($p<0.05$) higher than the T1, T2 and those treatments remains comparable regarding the cooking yield (%) of the chicken shikampuri kebabs.

The overall mean ± SE values of cooking yield (%) of C2, T4, T5 and T6 formulations were presented in table 14. Fig 6. Analysis of variance of the same was presented in table 20. The mean ± SE values of cooking yield of C2, T4, T5 and T6 were 89.59 ± 0.22, 91.42 ± 0.31, 91.99 ± 0.36 and 94.30 ± 0.20, respectively. All the treatments were significantly ($p<0.05$) higher than the control and T6 was significantly ($p<0.05$) higher than the T4, T5 and those treatments remains comparable regarding the cooking yield (%) of the mutton shikampuri kebabs.

Table 13: Mean ± SE of the physico-chemical properties of different formulations of chicken shikampuri kebab as affected by different components of egg as binder.

Parameter	Control 1	Treatment-1	Treatment-2	Treatment-3
pH	5.58±0.04[a]	5.65±0.03[a]	5.61±0.03[a]	5.68±0.02[a]
Cooking yield (%)	85.84±0.17[a]	86.65±0.23[ab]	86.98±0.22[b]	88.00±0.24[c]

Note: Means bearing common superscripts in each row do not differ significantly ($P<0.05$).

C1: Chicken control, T1: Chicken with egg albumen, T2: Chicken with egg yolk, T3: Chicken with whole egg.

Table 14: Mean ± SE of the Physico-chemical properties of different formulations of mutton shikampuri kebab as affected by different components of egg as binder.

Parameter	Control 2	Treatment-4	Treatment-5	Treatment-6
pH	5.53±0.03[a]	5.59±0.02[a]	5.55±0.02[a]	5.63±0.01[a]
Cooking yield (%)	89.59±0.22[a]	91.42±0.31[b]	91.99±0.36[b]	94.30±0.20[c]

Note: Means bearing common superscripts in each row do not differ significantly ($P<0.05$).

C2: Mutton control, T4: Mutton with egg albumen, T5: Mutton with egg yolk, T6: Mutton with whole egg.

Fig 3: pH values of chicken shikampuri kebab as affected by different liquid egg components as binder (egg albumen, egg yolk, whole egg)

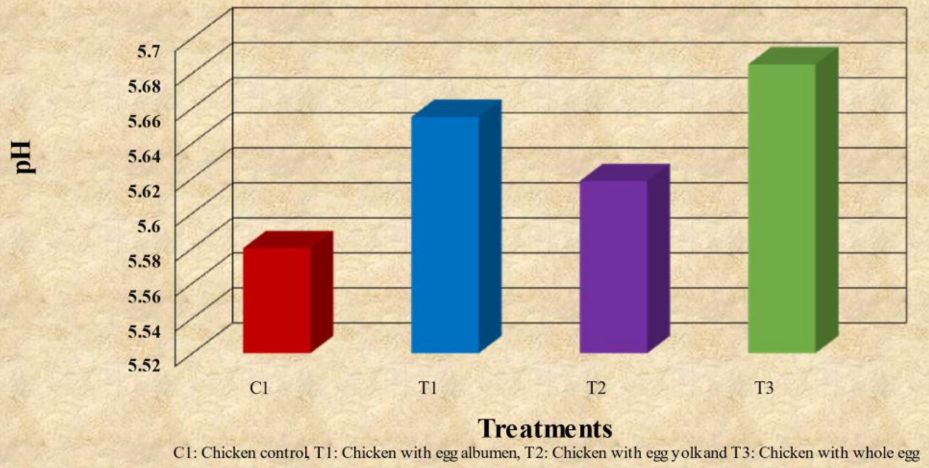


Fig 4: pH values of mutton shikampuri kebab as affected by different liquid egg components as binder (egg albumen, egg yolk, whole egg)

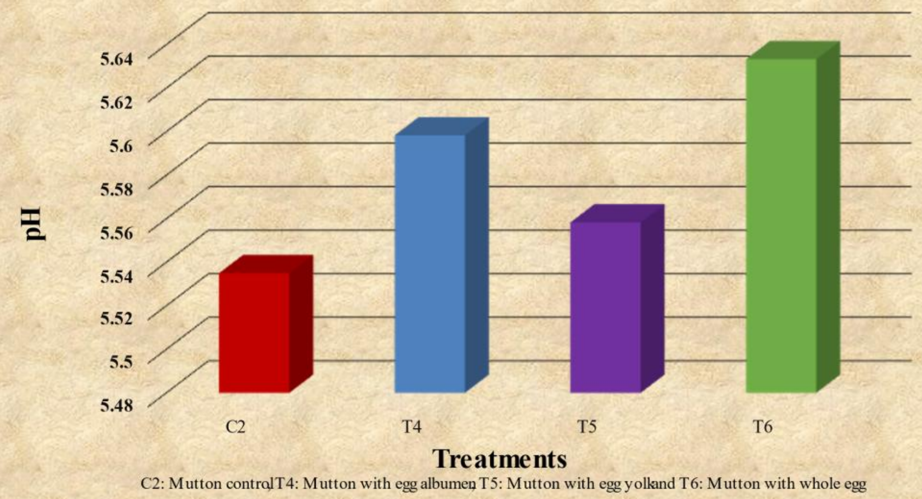
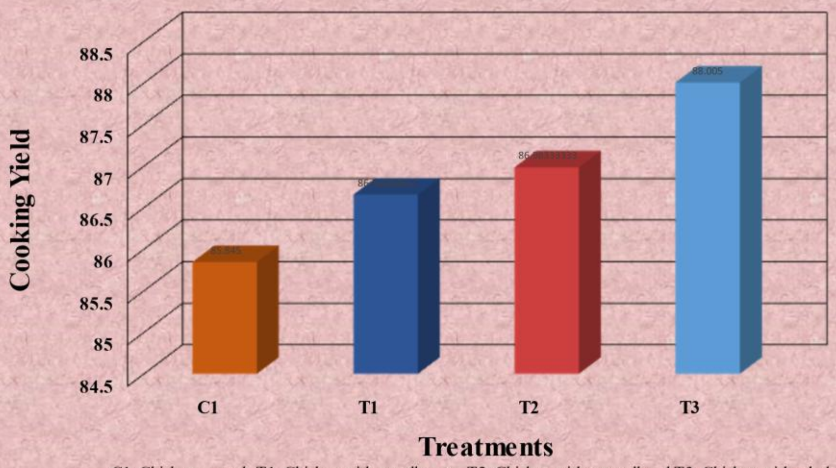
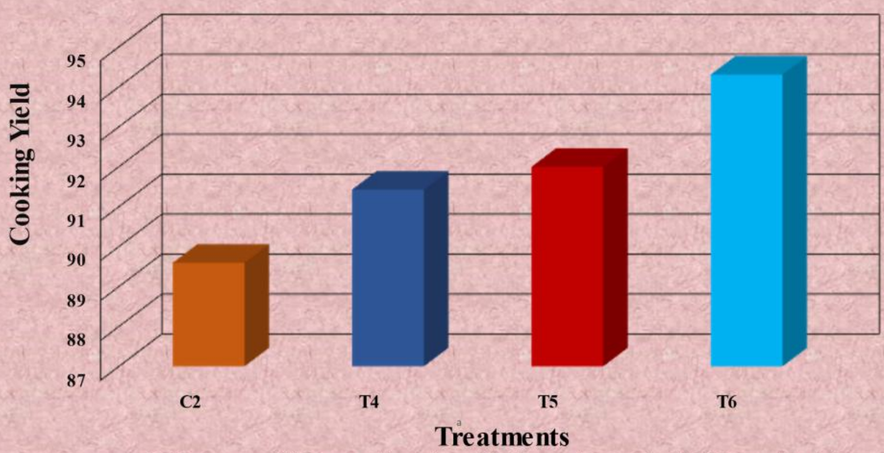


Fig 5: Cooking yield (%) values of chicken shikampuri kebab as affected by different liquid egg components as binder (egg albumen, egg yolk, whole egg)



C1: Chicken control , T1: Chicken with egg albumen ,T2: Chicken with egg yolk and T3: Chicken with whole egg

Fig 6: Cooking yield (%) values of mutton shikampuri kebab as affected by different liquid egg components as binder (egg albumen, egg yolk, whole egg)



C2: Mutton control, T4: Mutton with egg albumen, T5: Mutton with egg yolk and T6: Mutton with whole egg

4.4 PROXIMATE COMPOSITION

4.4.1 Percent Moisture

The overall mean ± SE values of percent moisture of C1, T1, T2 and T3 formulations were presented in table 15. Analysis of variance of the same was presented in table 19. The mean ± SE values of percent moisture in C1, T1, T2 and T3 Were 54.07 ± 0.21 58.50 ± 0.34 55.58 ± 0.31 and 56.31 ± 0.30, respectively. The overall mean percent moisture content of the treatments were significantly ($p<0.05$) higher than the C1. The treatments T2, T3 remains comparable and T1 is highly significant ($p<0.05$) than T2 and T3.

The overall mean ± SE values of percent moisture of C2, T4, T5 and T6 formulations were presented in table 16. Analysis of variance of the same was presented in table 20. The mean ± SE values of percent moisture in C2, T4, T5 and T6 were 56.96 ± 0.33, 60.88 ± 0.46, 57.70 ± 0.21 and 59.16 ± 0.32, respectively. The overall means of the samples C2 and T5 remains comparable and T4 was significantly ($p<0.05$) higher than T6 and it was significantly ($p<0.05$) higher than T5 regarding the percent moisture of the mutton shikampuri kebabs.

4.4.2 Percent Crude Protein

The overall mean ± SE values of percent crude protein of C1, T1, T2 and T3 were presented in table 15. Analysis of variance of the same was presented in table 19. The mean ± SE values of percent crude protein in C1, T1, T2 and T3 were 20.40±0.31, 22.03±0.30, 23.48±0.32 and 22.61±0.37, respectively. All the treatments were significantly ($p<0.05$) higher than the control and the overall mean values of the treatments remains comparable where T2 was non significantly higher regarding the percent crude protein of the chicken shikampuri kebabs.

The overall mean ± SE values of percent crude protein of C2, T4, T5 and T6 were presented in table 16. Analysis of variance of the same was presented in table 20. The mean ± SE values of percent crude protein in C2, T4, T5 and T6 were 17.70 ± 0.52, 19.57 ± 0.45, 21.24 ± 0.38 and 20.30 ± 0.39, respectively. All the treatments were significantly ($p<0.05$) higher than the control and the overall mean values of the treatments remains comparable where T5 was non significantly higher regarding the percent crude protein of the mutton shikampuri kebabs.

4.4.3 Percent crude fat

The overall mean ± SE values of percent crude fat of C1, T1, T2 and T3 were presented in table 15. Analysis of variance of the same was presented in table 19. The mean ± SE values of percent crude fat in shikampuri kebabs preparations of C1, T1, T2 and T3 were 12.87 ± 0.17, 13.49 ± 0.18, 15.46 ± 0.16 and 14.16 ± 0.2, respectively. The treatment T1 remains comparable with C1. T2 was significantly ($p<0.05$) higher than T1 and T3 and those remains comparable regarding the percent crude fat of the kebabs.

The overall mean ± SE values of percent crude fat of C2, T4, T5 and T6 were presented in table 16. Analysis of variance of the same was presented in table 20. The mean ± SE values of percent crude fat in shikampuri kebabs preparations of C2, T4, T5 and T6 were 13.92±0.29, 14.34±0.22, 16.01±0.16 and 15.25±0.21, respectively. The overall mean ± SE values treatment T4 remains comparable with C2. T5 was significantly ($p<0.05$) higher than T4 and T6 and those remains comparable regarding the percent crude fat of the mutton shikampuri kebabs.

4.4.4 Total ash

The overall mean ± SE values of total ash of preparation samples of C1, T1, T2 and T3 formulations were presented in table 15. Analysis of variance of the same was presented in table 19. The mean ± SE values of total ash of C1, T1, T2 and T3 were 3.17 ± 0.13, 3.39 ± 0.10, 3.76 ± 0.07 and 3.58 ± 0.06, respectively. The treatment T1 remains comparable with C1. The overall mean values remain comparable among all the treatments regarding the total ash of the chicken shikampuri kebabs.

The overall mean ± SE values of total ash of C2, T4, T5 and T6 formulations were presented in table 16. Analysis of variance of the same was presented in table 20. The mean ± SE values of total ash of C2, T4, T5 and T6 were 2.76 ± 0.07, 3.22 ± 0.12, 3.52 ± 0.08 and 3.39±0.10, respectively. All the treatments were significantly ($p<0.05$) higher than the C2 and remains comparable among the treatments regarding the total ash of the mutton shikampuri kebabs.

Table 15: Effects of different components of egg as binder on the proximate composition of chicken shikampuri kebab.

Parameter (%)	Control 1	Treatment -1	Treatment -2	Treatment -3
Moisture	54.07 ± 0.21^{a}	58.50 ± 0.34^{c}	55.58 ± 0.31^{b}	56.31 ± 0.30^{b}
Crude protein	20.40 ± 0.31^{a}	22.03 ± 0.30^{b}	23.48 ± 0.32^{b}	22.61 ± 0.37^{b}
Crude fat	12.87 ± 0.17^{a}	13.49 ± 0.18^{ab}	15.46 ± 0.16^{c}	14.16 ± 0.24^{b}
Total ash	3.17 ± 0.13^{a}	3.39 ± 0.10^{ab}	3.76 ± 0.07^{b}	3.58 ± 0.06^{b}

Note: Means bearing common superscripts in each row do not differ significantly ($P<0.05$).

C1: Chicken control, T1: Chicken with egg albumen, T2: Chicken with egg yolk, T3: Chicken with whole egg.

Table 16: Effects of different components of egg as binder on the proximate composition of mutton shikampuri kebab.

Parameter (%)	Control 2	Treatment -4	Treatment -5	Treatment -6
Moisture	56.96 ± 0.33^{a}	60.88 ± 0.46^{c}	57.70 ± 0.21^{a}	59.16 ± 0.32^{b}
Crude protein	17.70 ± 0.52^{a}	19.57 ± 0.45^{b}	21.24 ± 0.38^{b}	20.30 ± 0.39^{b}
Crude fat	13.92 ± 0.29^{a}	14.34 ± 0.22^{ab}	16.01 ± 0.16^{c}	15.25 ± 0.21^{b}
Total ash	2.76 ± 0.07^{a}	3.22 ± 0.12^{b}	3.52 ± 0.08^{b}	3.39 ± 0.10^{b}

Note: Means bearing common superscripts in each row do not differ significantly ($P<0.05$).

C2: Mutton control, T4: Mutton with egg albumen, T5: Mutton with egg yolk, T6: Mutton with whole egg.

4.5 SENSORY EVALUATION

4.5.1 Appearance

The overall mean ± SE values of appearance of C1, T1, T2 and T3 formulations were presented in table 17. Analysis of variance of the same was presented in table 19. The mean ± SE values of appearance of C1, T1, T2 and T3 were 6.25 ± 0.11, 6.91 ± 0.15, 7.91 ± 0.15 and 7.83 ± 0.16, respectively. All the treatments were significantly ($p<0.05$) higher than the control and the overall mean values of the treatments T2, T3 remains comparable and significantly higher ($p<0.05$) than T1 regarding the appearance of the chicken shikampuri kebabs.

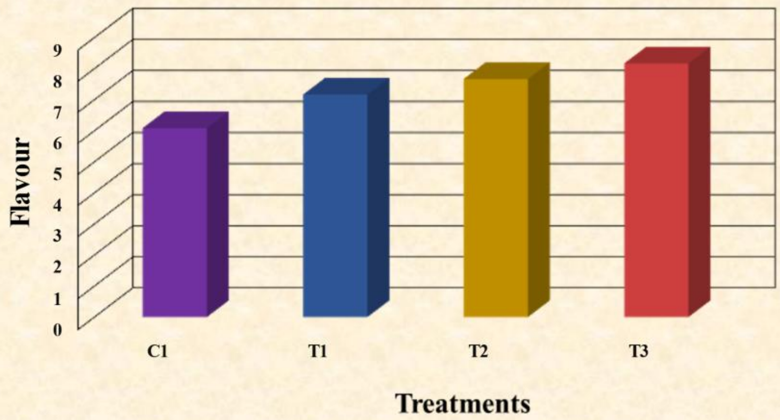
The overall mean ± SE values of appearance of C2, T4, T5 and T6 formulations were presented in table 18. Analysis of variance of the same was presented in table 20. The appearance of C2, T4, T5 and T6 were 6.3 ± 0.10, 7.08 ± 0.15, 8.16 ± 0.10 and 8.08 ± 0.15, respectively. All the treatments were significantly ($p<0.05$) higher than the control and the overall mean values of the treatments T5, T6 remains comparable and significantly higher ($p<0.05$) than T4 regarding the appearance of the mutton shikampuri kebabs.

4.5.2 Flavour

The overall mean ± SE values of flavour of C1, T1, T2 and T3 formulations were presented in table 17. Fig 7. Analysis of variance of the same was presented in table 19. The mean ± SE values of flavour of shikampuri kebab preparations of C1, T1, T2, and T3 were 6.08 ± 0.08, 7.16 ± 0.10, 7.66 ± 0.10 and 8.1 ± 0.10, respectively. All the treatments were significantly ($p<0.05$) higher than the control and the overall mean values of T3 was significantly ($p<0.05$) higher than T2 and this was significantly ($p<0.05$) higher than T1 regarding the flavour of the chicken shikampuri kebabs.

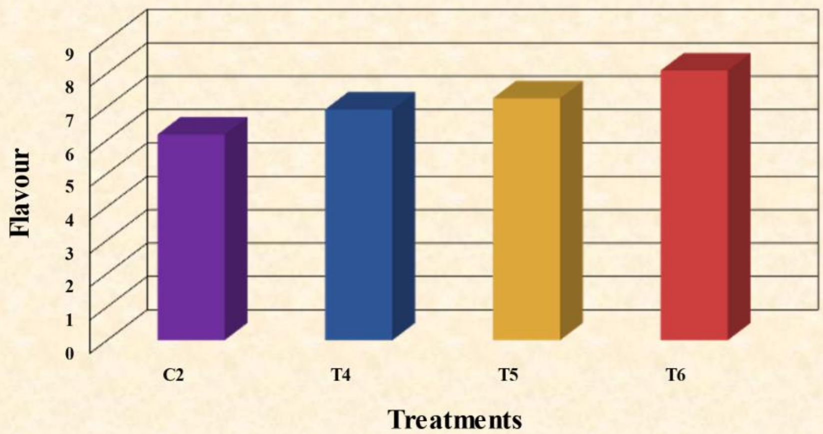
The overall mean ± SE values of flavour of C2, T4, T5 and T6 formulations were presented in table 18. Analysis of variance of the same was presented in table 20. Fig 8. The mean ± SE values of flavour of C2, T4, T5 and T6 were 6.16 ± 0.10, 6.91 ± 0.20, 7.25 ± 0.11 and 8.08 ± 0.15, respectively. All the treatments were significantly ($p<0.05$) higher than the control and the overall mean values of the treatments T4, T5 remains comparable and T6 was significantly higher ($p<0.05$) with in the treatments regarding the flavour of the mutton shikampuri kebabs.

Fig 7: Flavour values of chicken shikampuri kebab as affected by different liquid egg components as binder (egg albumen, egg yolk, whole egg)



C1: Chicken control, T1: Chicken with egg albumen, T2: Chicken with egg yolk and T3: Chicken with whole egg

Fig 8: Flavour values of mutton shikampuri kebab as affected by different liquid egg components as binder (egg albumen, egg yolk, whole egg).



C2: Mutton control, T4: Mutton with egg albumen, T5: Mutton with egg yolk and T6: Mutton with whole egg

4.5.3 Meat Intensity Flavour

The overall mean ± SE values of meat intensity flavour of C1, T1, T2 and T3 formulations were presented in table 17. Analysis of variance of the same was presented in table 19. The mean ± SE values of meat intensity flavour of shikampuri kebab preparations of C1, T1, T2 and T3 were 7.66 ± 0.10, 7.16 ± 0.10, 7.25 ± 0.11 and 7.66 ± 0.10, respectively. the treatments T2, T3 remains comparable with the control and the overall mean value of T1 was significantly ($p<0.05$) lower than T2 and T3 regarding the meat intensity flavour of the chicken shikampuri kebabs.

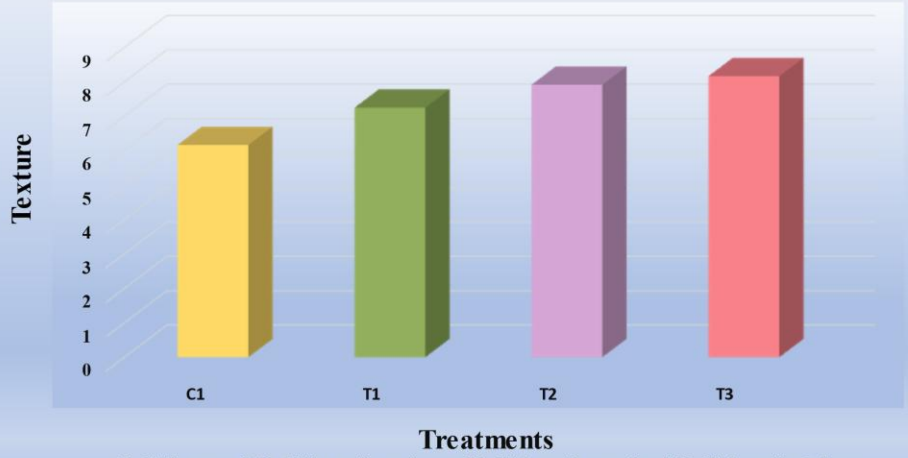
The overall mean ± SE values of meat intensity flavour of C2, T4, T5 and T6 formulations were presented in table 18. Analysis of variance of the same was presented in table 20. The mean ± SE values of meat intensity flavour of C2, T4, T5 and T6 were 7.66 ± 0.10, 7.08 ± 0.08, 7.16 ± 0.10 and 7.58 ± 0.15, respectively. T6 remains comparable with C2. T4, T5 remains comparable and T6 was significantly ($p<0.05$) higher with in the treatments regarding the meat intensity flavour of the mutton shikampuri kebabs.

4.5.4 Texture

The overall mean ± SE values of texture of C1, T1, T2 and T3 formulations were shown in table 17. Fig 9. Analysis of variance of the same was presented in table 19. The mean ± SE values of texture of shikampuri kebab preparations of C1, T1, T2 and T3 were 6.16 ± 0.10, 7.25 ± 0.11, 7.91 ± 0.15 and 8.16 ± 0.10, respectively. All the treatments were significantly ($p<0.05$) higher than the control and the treatments T2, T3 remains comparable and those were significantly ($p<0.05$) higher than T1 regarding the texture of the chicken shikampuri kebabs.

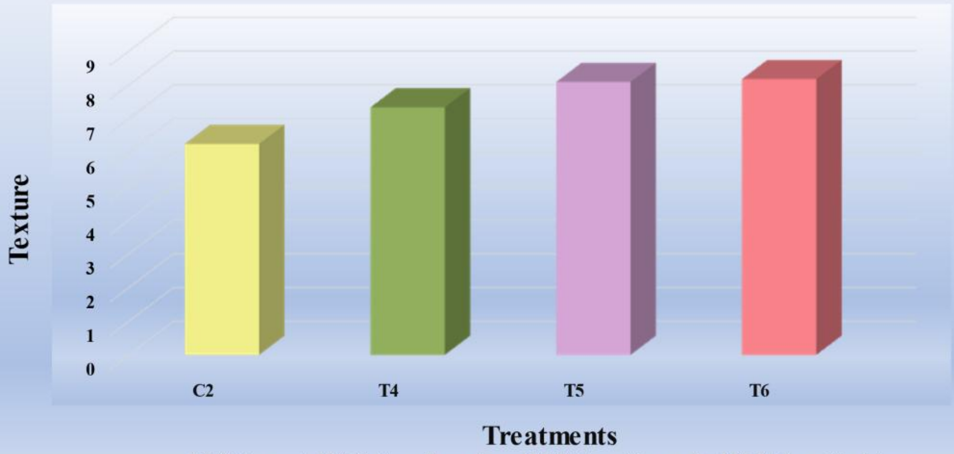
The overall mean ± SE values of texture of C2, T4, T5 and T6 formulations were presented in table 18. Fig 10. Analysis of variance of the same was presented in table 20. The mean ± SE values of texture of C2, T4, T5 and T6 were 6.25 ± 0.11, 7.33 ± 0.10, 8.08 ± 0.08 and 8.16 ± 0.16, respectively. All the treatments were significantly ($p<0.05$) higher than the control and the treatments T5, T6 remains comparable and those treatments were significantly ($p<0.05$) higher than T4 regarding the texture of the mutton shikampuri kebabs.

Fig 9: Texture values of chicken shikampuri kebab as affected by different liquid egg components as binder (egg albumen, egg yolk, whole egg)



C1: Chicken control, T1: Chicken with egg albumen, T2: Chicken with egg yolk and T3: Chicken with whole egg

Fig 10: Texture values of mutton shikampuri kebab as affected by different liquid egg components as binder (egg albumen, egg yolk, whole egg)



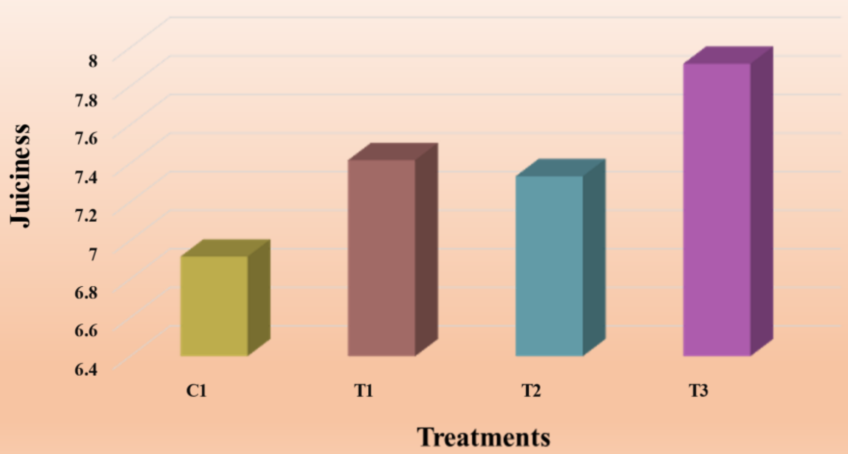
C2: Mutton control, T4: Mutton with egg albumen, T5: Mutton with egg yolk and T6: Mutton with whole egg

4.5.5 Juiciness

The overall mean ± SE values of juiciness of C1, T1, T2 and T3 formulations were shown in table 17. Analysis of variance of the same was presented in table 19. Fig 11. The mean ± SE values of texture of shikampuri kebab preparations of C1, T1, T2 and T3 were 6.91 ± 0.15, 7.41 ± 0.15, 7.33 ± 0.10 and 7.91 ± 0.15, respectively. The treatments T1 and T2 remains comparable with control and T1 and T3 remains comparable and those treatments were significantly ($p<0.05$) higher than T2 regarding the juiciness of the chicken shikampuri kebabs.

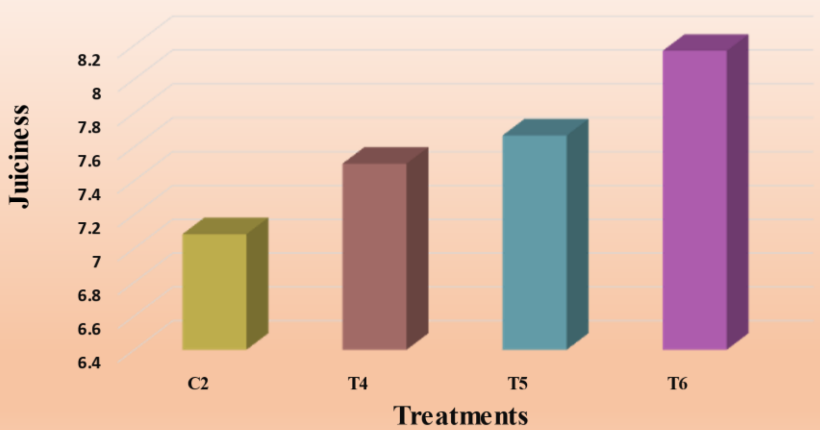
The overall mean ± SE values of juiciness of C2, T4, T5 and T6 formulations were presented in table 18. Analysis of variance of the same was presented in table 20. Fig 12. The mean ± SE values of texture of C2, T4, T5 and T6 were 7.08 ± 0.15, 7.50 ± 0.12, 7.66 ± 0.16 and 8.16 ± 0.10, respectively. T4 remains comparable C2. T6 was significantly ($p<0.05$) higher than T4 and remains comparable with T5 regarding the juiciness of the mutton shikampuri kebabs.

Fig 11: Juiciness values of chicken shikampuri kebab as affected by different liquid egg components as binder (egg albumen, egg yolk, whole egg)



C1: Chicken control, T1: Chicken with egg albumen, T2: Chicken with egg yolk and T3: Chicken with whole egg

Fig 12: Juiciness values of mutton shikampuri kebab as affected by different liquid egg components as binder (egg albumen, egg yolk, whole egg)



C2: Mutton control, T4: Mutton with egg albumen, T5: Mutton with egg yolk and T6: Mutton with whole egg

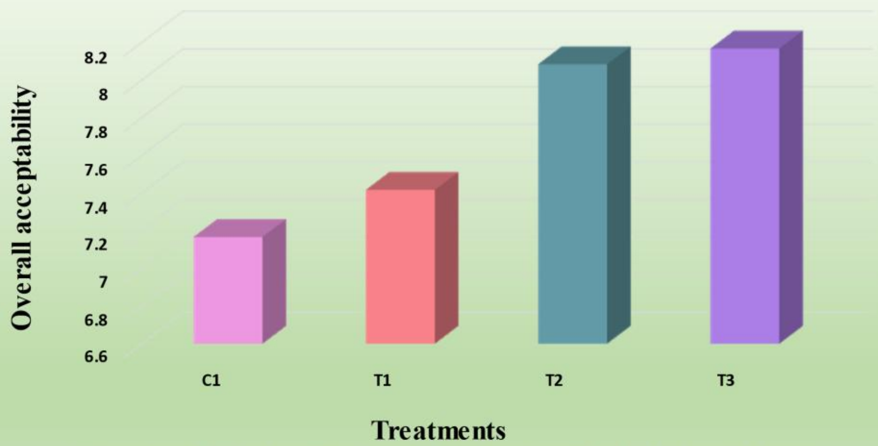
4.5.6 Overall Acceptability

The overall mean ± SE values of overall acceptability of C1, T1, T2 and T3 formulations were shown in table 17. Fig 13. Analysis of variance of the same was presented in table 19. Fig 14. The mean ± SE values of overall acceptability of shikampuri kebab preparations of C1, T1, T2 and T3 were 7.16 ± 0.10, 7.41 ± 0.08, 8.08 ± 0.08 and 8.16 ± 0.10, respectively. The treatments T1 remains comparable with control and the treatments T2 and T3 remains comparable and those treatments were significantly ($p<0.05$) higher than T1 regarding the overall acceptability of the chicken shikampuri kebabs.

The overall mean ± SE values of overall acceptability of C2, T4, T5 and T6 formulations were presented in table 18. Fig 14. Analysis of variance of the same was presented in table 20. The mean ± SE values of overall acceptability of C2, T4, T5 and T6 were 7.08 ± 0.08, 7.33 ± 0.10, 8.00 ± 0.18 and 8.25 ± 0.11, respectively. the treatments T4 remains comparable with control and the treatments T5 and T6 remains comparable and those treatments were significantly ($p<0.05$) higher than T4 regarding the overall acceptability of the mutton shikampuri kebabs.

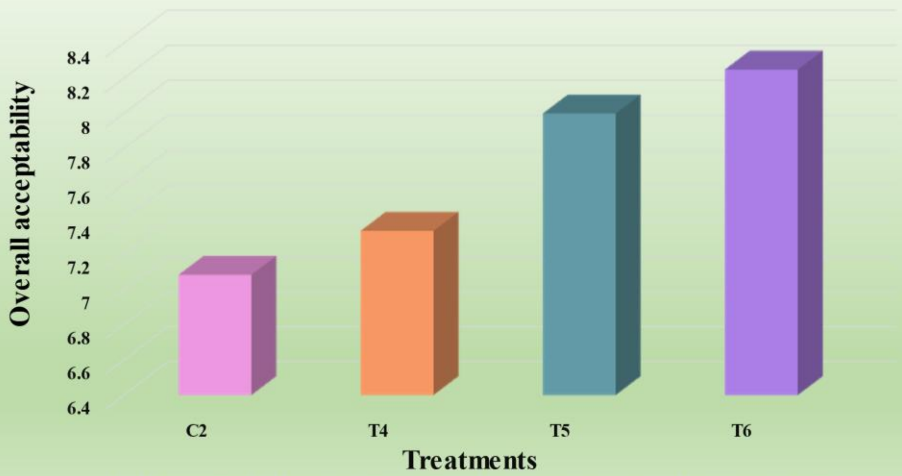
The data thus obtained was statistically analysed and revealed that chicken shikampuri kebab preparation with whole egg (T3) and mutton shikampuri kebab with whole egg (T6) were better in terms of physico-chemical and sensory quality. Hence, they were selected for further storage studies along with control.

Fig 13: Overall acceptability values of chicken shikampuri kebab as affected by different liquid egg components as binder (egg albumen, egg yolk, whole egg)



C1: Chicken control, T1: Chicken with egg albumen, T2: Chicken with egg yolk and T3: Chicken with whole egg

Fig 14: Overall acceptability values of mutton shikampuri kebab as affected by different liquid egg components as binder (egg albumen, egg yolk, whole egg).



C2: Mutton control, T4: Mutton with egg albumen, T5: Mutton with egg yolk and T6: Mutton with whole egg

Table 17: Effect of different components of egg as binder on the sensory evaluation chicken shikampuri kebab.

Parameter	Control-1	Treatment-1	Treatment-2	Treatment-3
Appearance	6.25 ± 0.11^{a}	6.91 ± 0.15^{b}	7.91 ± 0.15^{c}	7.83 ± 0.16^{c}
Flavor	6.08 ± 0.08^{a}	7.16 ± 0.10^{b}	7.66 ± 0.10^{c}	8.1 ± 0.10^{d}
Meat Intensity Flavor	7.66 ± 0.10^{b}	7.16 ± 0.10^{a}	7.25 ± 0.11^{ab}	7.66 ± 0.10^{b}
Texture	6.16 ± 0.10^{a}	7.25 ± 0.11^{b}	7.91 ± 0.15^{c}	8.16 ± 0.10^{c}
Juiciness	6.91 ± 0.15^{a}	7.41 ± 0.15^{ab}	7.33 ± 0.10^{a}	7.91 ± 0.15^{b}
Overall acceptability	7.16 ± 0.10^{a}	7.41 ± 0.08^{a}	8.08 ± 0.08^{b}	8.16 ± 0.10^{b}

Note: Means bearing common superscripts in each row do not differ significantly ($P<0.05$).

C1: Chicken control, T1: Chicken with egg albumen, T2: Chicken with egg yolk, T3: Chicken with whole egg.

Table 18: Effect of different components of egg as binder on the sensory evaluation mutton shikampuri kebab.

Parameter	Control-2	Treatment-4	Treatment-5	Treatment-6
Appearance	6.30 ± 0.10^{a}	7.08 ± 0.15^{b}	8.16 ± 0.10^{c}	8.08 ± 0.15^{c}
Flavor	6.16 ± 0.10^{a}	6.91 ± 0.20^{b}	7.25 ± 0.11^{b}	8.08 ± 0.15^{c}
Meat Intensity Flavor	7.66 ± 0.10^{c}	7.08 ± 0.08^{a}	7.16 ± 0.10^{ab}	7.58 ± 0.15^{bc}
Texture	6.25 ± 0.11^{a}	7.33 ± 0.10^{b}	8.08 ± 0.08^{c}	8.16 ± 0.16^{c}
Juiciness	7.08 ± 0.15^{a}	7.50 ± 0.12^{ab}	7.66 ± 0.16^{bc}	8.16 ± 0.10^{c}
Overall acceptability	7.08 ± 0.08^{a}	7.33 ± 0.10^{a}	8.00 ± 0.18^{b}	8.25 ± 0.11^{b}

Note: Means bearing common superscripts in each row do not differ significantly ($P<0.05$).

C2: Mutton control, T4: Mutton with egg albumen, T5: Mutton with egg yolk, T6: Mutton with whole egg.

Table 19: Analysis of Variance of physico-chemical, proximate analysis and sensory scores of chicken shikampuri kebabs as affected by different components of liquid egg (egg albumen, egg yolk, whole egg).

Parameter		SS	df	MS	F
pH	Between groups	.037	3	.012	1.526^{NS}
	Within groups	.163	20	.008	
	Total	.200	23		
COOKING YIELD	Between groups	14.383	3	4.794	16.700**
	Within groups	5.742	20	.287	
	Total	20.125	23		
PERCENT MOISTURE CONTENT	Between groups	61.196	3	20.399	38.187**
	Within groups	10.684	20	.534	
	Total	71.880	23		
PERCENT CRUDE PROTEIN	Between groups	36.049	3	12.016	18.393**
	Within groups	13.066	20	.653	
	Total	49.116	23		
PERCENT ETHER EXTRACT	Between groups	22.170	3	7.390	32.641**
	Within groups	4.528	20	.226	
	Total	26.698	23		
TOTAL ASH	Between groups	1.165	3	.388	6.676**
	Within groups	1.163	20	.058	
	Total	2.328	23		
APPEARANCE	Between groups	11.365	3	3.788	28.862**
	Within groups	2.625	20	.131	
	Total	13.990	23		
FLAVOUR	Between groups	14.281	3	4.760	78.793**
	Within groups	1.208	20	.060	
	Total	15.490	23		
MEAT	Between groups	1.281	3	.427	6.212**

INTENSITY FLAVOUR	Within groups	1.375	20	.069	
	Total	2.656	23		
TEXTURE	Between groups	14.375	3	4.792	54.762**
	Within groups	1.750	20	.088	
	Total	16.125	23		
JUICINESS	Between groups	3.031	3	1.010	8.220**
	Within groups	2.458	20	.123	
	Total	5.490	23		
OVERALL ACCEPTABILITY	Between groups	4.375	3	1.458	26.923**
	Within groups	1.083	20	.054	
	Total	5.458	23		

***Means significant, **Means Highly Significant,**
NS – Non Significant, SS – Some of squares, MS – Mean Square
df- degrees of freedom, F- F-ratio

Table 20: Analysis of Variance of physico-chemical, proximate analysis and sensory scores of mutton shikampuri kebabs as affected by different components of liquid egg (egg albumen, egg yolk, whole egg).

Parameter		SS	df	MS	F
pH	Between groups	.034	3	.011	2.524^{NS}
	Within groups	.090	20	.004	
	Total	.124	23		
COOKING YIELD	Between groups	67.909	3	22.636	46.693**
	Within groups	9.696	20	.485	
	Total	77.605	23		
PERCENT MOISTURE CONTENT	Between groups	53.852	3	17.951	24.966**
	Within groups	14.380	20	.719	
	Total	68.232	23		
PERCENT CRUDE PROTEIN	Between groups	40.500	3	13.500	11.431**
	Within groups	23.620	20	1.181	
	Total	64.120	23		
PERCENT ETHER EXTRACT	Between groups	15.676	3	5.225	16.589**
	Within groups	6.300	20	.315	
	Total	21.975	23		
TOTAL ASH	Between groups	1.983	3	.661	11.036**
	Within groups	1.198	20	.060	
	Total	3.181	23		
APPEARANCE	Between groups	13.750	3	4.583	44.000**
	Within groups	2.083	20	.104	
	Total	15.833	23		
FLAVOUR	Between groups	11.365	3	3.788	28.862**
	Within groups	2.625	20	.131	
	Total	13.990	23		
MEAT	Between groups	1.542	3	.514	6.491**

INTENSITY FLAVOUR	Within groups	1.583	20	.079	
	Total	3.125	23		
TEXTURE	Between groups	14.208	3	4.736	54.127**
	Within groups	1.750	20	.088	
	Total	15.958	23		
JUICINESS	Between groups	3.615	3	1.205	10.146**
	Within groups	2.375	20	.119	
	Total	5.990	23		
OVERALL ACCEPTABILITY	Between groups	5.417	3	1.806	18.841**
	Within groups	1.917	20	.096	
	Total	7.333	23		

***Means significant, **Means Highly Significant**

NS – Non Significant, SS – Some of squares, MS – Mean Square
df- degrees of freedom, F- F-ratio

4.6 EVALUATION OF STORAGE STABILITY OF BOTH MUTTON AND CHICKEN MEAT SHIKAMPURI KEBABS BY THE ADDITION OF WHOLE EGG AS BINDER.

The treatments (T3, T6) and control of both chicken shikampuri kebabs and mutton shikampuri kebabs formulations were packaged in LDPE pouches under aerobic packaging and subjected to shelf-life studies under refrigeration (4 ± 1°C) temperature and evaluated at 2 days interval till spoilage. The data obtained for various quality parameters were presented below.

4.6.1 Physico-chemical characteristics

4.6.1.1 pH

The Mean ± S.E values of pH of both chicken shikampuri kebabs and mutton shikampuri kebabs as influenced by addition of egg as binder during 12 days of refrigeration (4 ± 1°C) storage period were presented in Table 21 and Table 22 respectively and analysis of variance of the same was presented in Table 45 and Table 46 respectively.

The Mean ± S.E values of pH of chicken shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 5.68±0.02, 5.72±0.03, 5.74±0.03, 5.89±0.02 and 6.12±0.05, respectively. The same values for control chicken shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were, 5.58±0.04, 5.63±0.02, 5.69±0.03, 5.82±0.02 and 5.98±0.03 respectively.

The overall mean pH values of control and chicken shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean pH values of chicken shikampuri kebabs were significantly ($P<0.05$) higher than the control and the mean values for both control and chicken shikampuri kebabs with whole egg were in the range of 5.63 to 6.05 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

The Mean ± S.E values of pH of mutton shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 5.63±0.01, 5.69±0.02, 5.71±0.02, 5.84±0.03 and 5.98±0.04, respectively. The same values for control mutton shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 5.53±0.03, 5.57±0.04, 5.65±0.02, 5.77±0.02 and 5.91±0.01, respectively.

The overall mean pH values of control and mutton shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean pH values of mutton shikampuri kebabs with whole egg were significantly ($P<0.05$) higher than the control and the mean values for both control and mutton shikampuri kebabs with whole egg were in the range of 5.58to 5.94 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

Table 21: Mean ± S.E values of pH of chicken shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					VERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C1	5.58±0.04	5.63±0.02	5.69±0.03	5.82±0.02	5.98±0.03	**5.74±0.02^{x}**
T_3	5.68±0.02	5.72±0.03	5.74±0.03	5.89±0.02	6.12±0.05	**5.83±0.03^{y}**
OVERALL MEAN	**5.63±0.02^{a}**	**5.68±0.02^{a}**	**5.72±0.02^{a}**	**5.86±0.02^{b}**	**6.05±0.03^{c}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05)

Mean is average of six replications.

C1= Chicken shikampuri kebab without egg

T3= Chicken shikampuri kebab with whole egg.

Table 22: Mean ± S.E values of pH of mutton shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	**DAYS OF STORAGE**					**VERALL MEAN**
	DAY 0	**DAY 3**	**DAY 6**	**DAY 9**	**DAY 12**	
C2	5.53±0.03	5.57±0.04	5.65±0.02	5.77±0.02	5.91±0.01	**5.69 ± 0.02^{x}**
T_6	5.63±0.01	5.69±0.02	5.71±0.02	5.84±0.03	5.98±0.04	**5.77 ± 0.02^{y}**
OVERALL MEAN	**5.58 ± 0.02^{a}**	**5.63 ± 0.02^{ab}**	**5.68 ± 0.01^{b}**	**5.81 ± 0.02^{c}**	**5.94 ± 0.02^{d}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).
Mean is average of six replications.

C2= Mutton shikampuri kebab without egg.

T6= Mutton shikampuri kebab with whole egg.

4.6.1.2 Batter Stability (%)

The Mean ± S.E values of batter stability of both chicken shikampuri kebabs and mutton shikampuri kebabs as influenced by addition of whole egg as binder during 12 days of refrigeration (4 ± 1°C) storage period were presented in Table 23 and Table 24 respectively and analysis of variance of the same was presented in Table 45 and Table 46 respectively.

The Mean ± S.E values of batter stability of chicken shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 84.62±0.39, 84.21±0.37, 83.61±0.32, 82.96±0.24 and 81.81±0.47, respectively. The same values for control chicken shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 81.62±0.32, 81.32±0.24, 80.95±0.20, 80.61±0.17 and 80.32±0.18, respectively.

The overall mean batter stability of control and chicken shikampuri kebabs were non significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean batter stability values of chicken shikampuri kebabs were significantly ($P<0.05$) higher than the control and the mean batter stability for both control and chicken shikampuri kebabs with whole egg were in the range of 83.12 to 81.06 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

The Mean ± S.E values of batter stability of mutton shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 91.39±0.33, 90.90±0.33, 90.46±0.34, 89.70±0.39 and 88.41±0.34, respectively. The same values for control mutton shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 86.00±0.26, 85.31±0.30, 84.85±0.33, 84.41±0.32 and 83.30±0.17, respectively. The overall mean batter stability values of control and mutton shikampuri kebabs were non significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean batter stability values of mutton shikampuri kebabs were significantly ($P<0.05$) higher than the control and the mean batter stability values for both control and mutton shikampuri kebabs with whole egg were in the range of 88.69 to 85.89 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

Table 23: Mean ± S.E values of Batter Stability (%) of chicken shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	**DAYS OF STORAGE**					**OVERALL MEAN**
	AY 0	**DAY 3**	**DAY 6**	**DAY 9**	**DAY 12**	
C1	81.62±0.32	81.32±0.24	80.95±0.20	80.61±0.17	80.32±0.18	**80.96±0.13^{x}**
T_3	84.62±0.39	84.21±0.37	83.61±0.32	82.96±0.24	81.81±0.47	**83.44±0.22^{y}**
OVERALL MEAN	**83.12±0.51^{a}**	**82.76±0.48^{a}**	**82.28±0.44^{ab}**	**81.79±0.38^{ab}**	**81.06±0.25^{b}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C1= Chicken shikampuri kebab without egg.

T3= Chicken shikampuri kebab with whole egg.

Table 24: Mean ± S.E values of Batter Stability (%) of mutton shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C2	86.00±0.26	85.31±0.30	84.85±0.33	84.41±0.32	83.30±0.17	**84.78±0.20^{x}**
T_6	91.39±0.33	90.90±0.33	90.46±0.34	89.70±0.39	88.41±0.34	**90.17±0.24^{y}**
OVERALL MEAN	**88.69±0.83^{a}**	**88.11±0.86^{a}**	**87.65±0.87^{ab}**	**87.06±0.83^{ab}**	**85.86±0.79^{b}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C2= Mutton shikampuri kebab without egg.

T6= Mutton shikampuri kebab with whole egg.

4.6.1.3 Thiobarbituric acid reactive substances (2-TBARS) value

The Mean ± S.E values of 2-TBARS (mg malonaldehyde/kg product) of both chicken shikampuri kebabs and Mutton shikampuri kebabs as influenced by addition of whole egg as binder during 12 days of refrigeration (4 ± 1°C) storage period were presented in Table 25, Table 26, Fig. 15 and Fig.16 respectively and analysis of variance of the same was presented in Table 45 and Table 46 respectively.

The Mean ± S.E values of 2-TBARS (mg malonaldehyde/kg product) in chicken shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 0.32±0.02, 0.48±0.04, 0.57±0.03, 0.73±0.04 and 0.94±0.08, respectively. The same values for control chicken shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 0.26±0.03, 0.41±0.04, 0.52±0.05, 0.68±0.04 and 0.91±0.08 respectively.

The overall mean 2-TBARS values of control and chicken shikampuri kebabs were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean values of chicken shikampuri kebabs were significantly ($P<0.05$) higher than the control and the mean 2-TBARS values for both control and chicken shikampuri kebabs with whole egg were in the range of 0.29 to 0.93 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

The Mean ± S.E values of 2-TBARS values of mutton shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 0.47±0.02, 0.60±0.01, 0.76±0.02, 0.87±0.04 and 1.10±0.06, respectively. The same values for control mutton shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4

± 1°C) temperature were 0.41±0.03, 0.55±0.02, 0.67±0.01, 0.84±0.04 and 1.02±0.07, respectively.

The overall mean 2-TBARS values of control and mutton shikampuri kebabs were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean 2-TBARS values of mutton shikampuri kebabs were significantly ($P<0.05$) higher than the control and the mean 2-TBARS values for both control and mutton shikampuri kebabs with whole egg were in the range of 0.44 to 1.06 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

Table 25: Mean ± S.E values of 2-TBARS (*mg malonaldehyde/kg sample*) of chicken shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C1	0.26±0.03	0.41±0.04	0.52±0.05	0.68±0.04	0.91±0.08	**0.55±0.04^{x}**
T_3	0.32±0.02	0.48±0.04	0.57±0.03	0.73±0.04	0.94±0.08	**0.61±0.04^{y}**
OVERALL MEAN	**0.29±0.02^{a}**	**0.44±0.03^{b}**	**0.54±0.03^{b}**	**0.71±0.03^{c}**	**0.93±0.05^{e}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05)

Mean is average of six replications

C1= Chicken shikampuri kebab without egg.

T3= Chicken shikampuri kebab with whole egg.

Table 26: Mean ± S.E values of 2-TBARS (*mg malonaldehyde/kg sample*) of mutton shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C2	0.41±0.03	0.55±0.02	0.67±0.01	0.84±0.04	1.02±0.07	**0.70 ± 0.04^{x}**
T_6	0.47±0.02	0.60±0.01	0.76±0.02	0.87±0.04	1.10±0.06	**0.76 ± 0.04^{y}**
OVERALL MEAN	**0.44 ± 0.02^{a}**	**0.58 ± 0.01^{b}**	**0.71 ± 0.09^{c}**	**0.85 ± 0.02^{d}**	**1.06 ± 0.04^{e}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly ($P<0.05$)

Mean is average of six replications

C2= Mutton shikampuri kebab without egg.

T6= Mutton shikampuri kebab with whole egg.

Fig 15: 2-TBARS values of chicken shikampuri kebab as influenced by incorporation of liquid whole egg as binder during refrigeration (4 ±1°C) storage

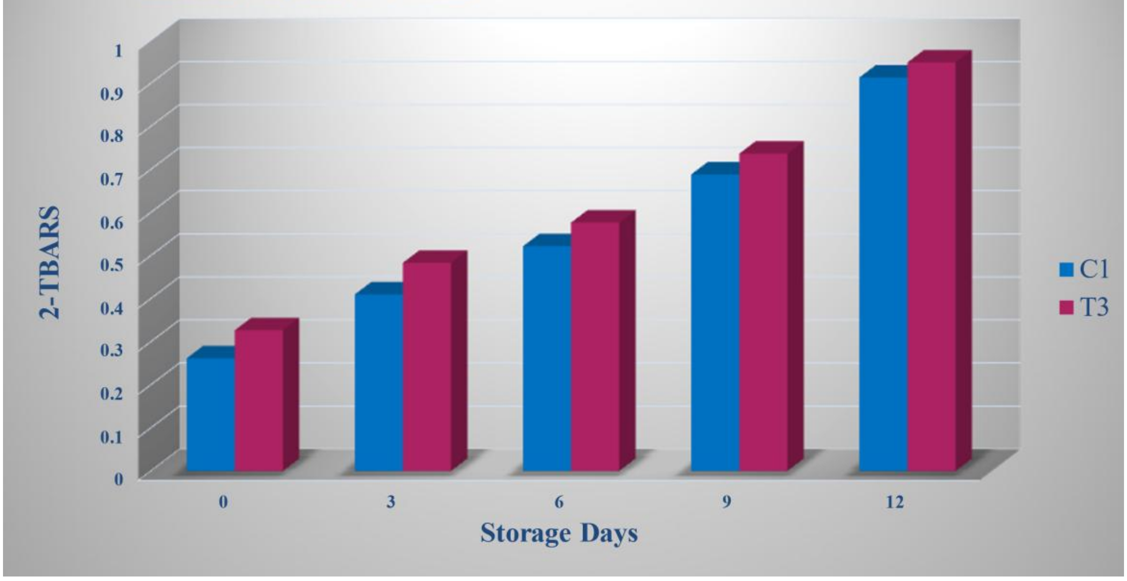
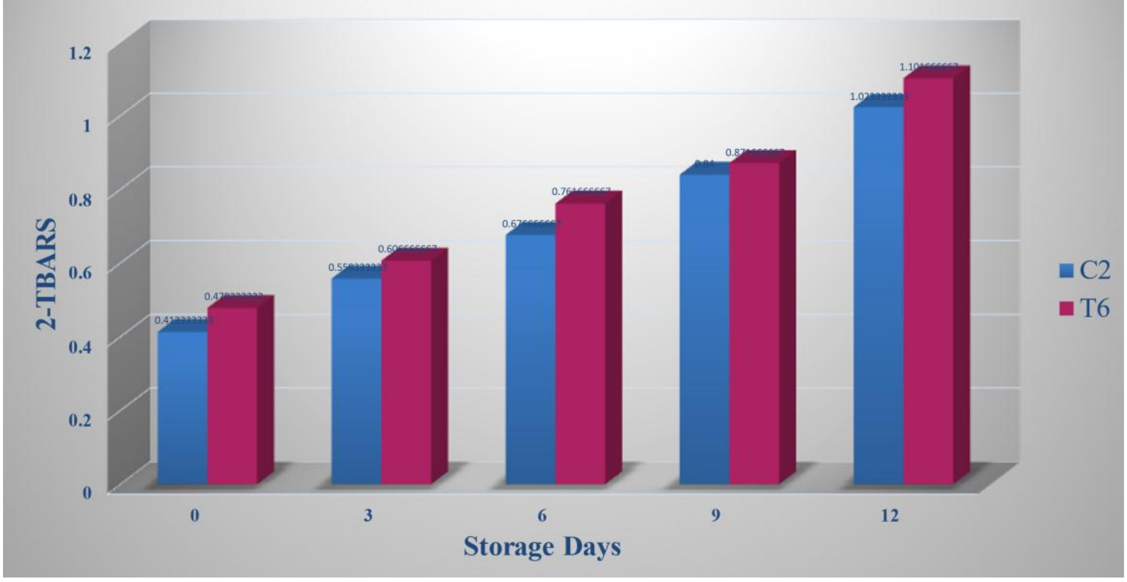


Fig.16: 2-TBARS values of mutton shikampuri kebab as influenced by incorporation of liquid whole egg as binder during refrigeration (4 ±1°C) storage.



4.6.1.4 Tyrosine Value (mg/100g)

The Mean ± S.E values of Tyrosine value of both chicken shikampuri kebabs and mutton shikampuri kebabs as influenced by addition of whole egg as binder during 12 days of refrigeration (4 ± 1°C) storage period were presented in Table 27, Table 28, Fig.17 and Fig.18 respectively and analysis of variance of the same was presented in Table 45 and Table 46 respectively.

The Mean ± S.E values of Tyrosine value in chicken shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 0.68 ±0.04, 0.95±0.08, 1.88±0.05, 2.42±0.06 and 2.53±0.06, respectively. The same values for control chicken shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 0.61±0.04, 0.91±0.06, 1.82±0.03, 2.36±0.07 and 2.48±0.04, respectively.

The overall mean tyrosine values of control and chicken shikampuri kebabs were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean values of chicken shikampuri kebabs were significantly ($P<0.05$) higher than the control and the mean tyrosine values for both control and chicken shikampuri kebabs with whole egg were in the range of 0.65 to 2.51 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

The Mean ± S.E values of tyrosine value of mutton shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 0.62±0.03, 0.98±0.09, 1.82±0.04, 2.23±0.05 and 2.48±0.04, respectively. The same values for control mutton shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4

± 1°C) temperature were 0.55±0.04, 0.87±0.03, 1.75±0.05, 2.21±0.05 and 2.43±0.03, respectively.

The overall mean tyrosine values of control and mutton shikampuri kebabs were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean tyrosine values of mutton shikampuri kebabs were significantly ($P<0.05$) higher than the control and the mean tyrosine values for both control and mutton shikampuri kebabs with whole egg were in the range of 0.58 to 2.45 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

Table 27: Mean ± S.E tyrosine value (mg/100g) of chicken shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C1	0.61±0.04	0.91±0.06	1.82±0.03	2.36±0.07	2.48±0.04	**1.64±0.12^{x}**
T_3	0.68 ±0.04	0.95±0.08	1.88±0.05	2.42±0.06	2.53±0.06	**1.69±0.14^{y}**
OVERALL MEAN	**0.65±0.03^{a}**	**0.93±0.05^{b}**	**1.85±0.03^{c}**	**2.39±0.04^{d}**	**2.51±0.03^{e}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).
Mean is average of six replications.

C1= Chicken shikampuri kebab without egg.

T3= Chicken shikampuri kebab with whole egg.

Table 28: Mean ± S.E tyrosine value (mg/100g) of mutton shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C2	0.55±0.04	0.87±0.03	1.75±0.05	2.21±0.05	2.43±0.03	**1.56±0.13^{x}**
T_6	0.62±0.03	0.98±0.09	1.82±0.04	2.23±0.05	2.48±0.04	**1.62±0.13^{y}**
OVERALL MEAN	**0.58±0.03^{a}**	**0.92±0.05^{b}**	**1.79±0.03^{c}**	**2.22±0.03^{d}**	**2.45±0.02^{e}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C2= Mutton shikampuri kebab without egg.

T6= Mutton shikampuri kebab with whole egg.

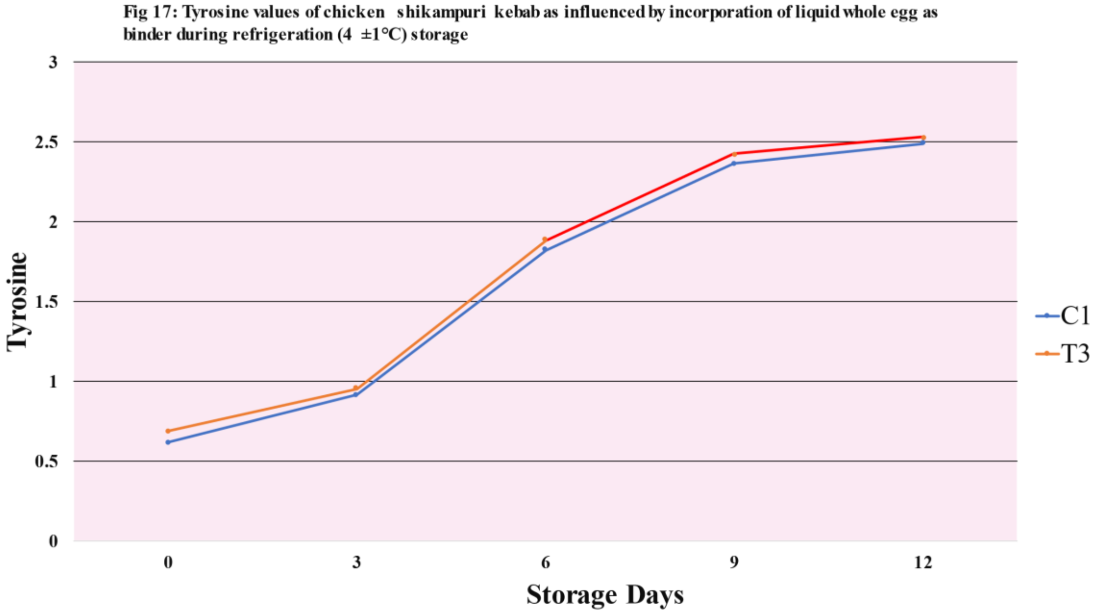


Fig 17: Tyrosine values of chicken shikampuri kebab as influenced by incorporation of liquid whole egg as binder during refrigeration (4 ±1°C) storage
Tyrosine
Storage Days
0
0.5
1
1.5
2
2.5
3
0
3
6
9
12
C1
T3

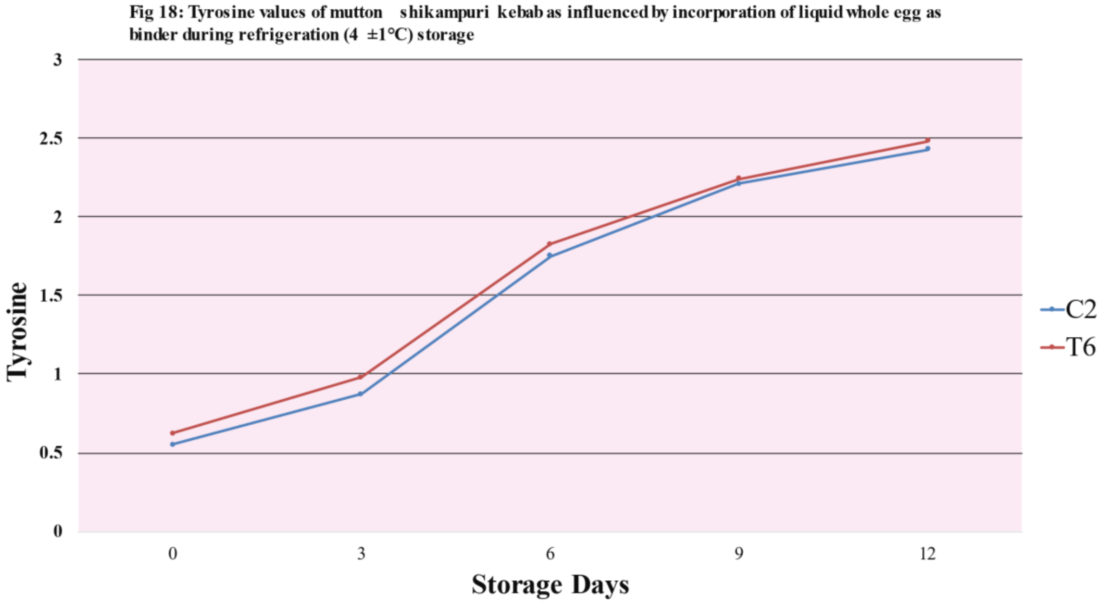


Fig 18: Tyrosine values of mutton shikampuri kebab as influenced by incorporation of liquid whole egg as binder during refrigeration (4 ±1°C) storage
Tyrosine
Storage Days
0
0.5
1
1.5
2
2.5
3
0
3
6
9
12
C2
T6

4.6.2 Microbial evaluation

4.6.2.1 Total plate count

The Mean ± S.E values of total plate count of both chicken shikampuri kebabs and mutton shikampuri kebabs as influenced by addition of whole egg as binder during 12 days of refrigeration (4 ± 1°C) storage period were presented in Table 29, Table 30, Fig.19 and Fig.20 respectively and analysis of variance of the same was presented in Table 45 and Table 46 respectively.

The Mean ± S.E values of total plate count of chicken shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 1.66±0.04, 2.21±0.07, 3.18±0.09, 4.68±0.05 and 5.99±0.07, respectively. The same values for control chicken shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 1.82±0.07, 2.59±0.09, 3.74±0.06, 5.02±0.02 and 6.21±0.10, respectively.

The overall mean total plate count of control and chicken shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean total plate count values of chicken shikampuri kebabs with whole egg were significantly ($P<0.05$) lower than the control and the mean total plate count for both control and chicken shikampuri kebabs with whole egg were in the range of 1.74 to 6.10 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

The Mean ± S.E values of total plate count of mutton shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 1.55±0.06, 2.13±0.04, 2.99±0.09, 4.51±0.06 and 5.75±0.05, respectively. The same values for control mutton shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 1.75±0.03, 2.38±0.07, 3.53±0.08, 4.75±0.06 and 5.84±0.05, respectively.

The overall mean total plate count values of control and mutton shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean total plate count values of mutton shikampuri kebabs were significantly ($P<0.05$) lower than the control and the mean total plate count values for both control and mutton shikampuri kebabs with whole egg were in the range of 1.64 to 5.85 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

Table 29: Mean ± S.E values of total plate count (*log10 CFU/g of sample*) of chicken shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage.

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C1	1.82±0.07	2.59±0.09	3.74±0.06	5.02±0.02	6.21±0.10	**3.88±0.29^{x}**
T_3	1.66±0.04	2.21±0.07	3.18±0.09	4.68±0.05	5.99±0.07	**3.54±0.28^{y}**
OVERALL MEAN	**1.74±0.04^{a}**	**2.40±0.06^{b}**	**3.46±0.08^{c}**	**4.99±0.02^{d}**	**6.10±0.07^{e}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C1= Chicken shikampuri kebab without egg.

T3= Chicken shikampuri kebab with whole egg.

Table 30: Mean ± S.E values of total plate count (*log10 CFU/g of sample*) of mutton shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C2	1.73±0.06	2.40±0.08	3.51±0.07	4.75±0.06	5.96±0.07	**3.67±0.27**^{x}
T_6	1.55±0.06	2.13±0.04	2.99±0.09	4.51±0.06	5.75±0.05	**3.39±0.29**^{y}
OVERALL MEAN	**1.64±0.05**^{a}	**2.26±0.06**^{b}	**3.25±0.09**^{c}	**4.63±0.05**^{d}	**5.85±0.04**^{e}	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C2= Mutton shikampuri kebab without egg.

T6= Mutton shikampuri kebab with whole egg.

Fig 19: Total plate count values of chicken shikampuri kebab as influenced by incorporation of liquid whole egg as binder during refrigeration (4 ±1°C) storage

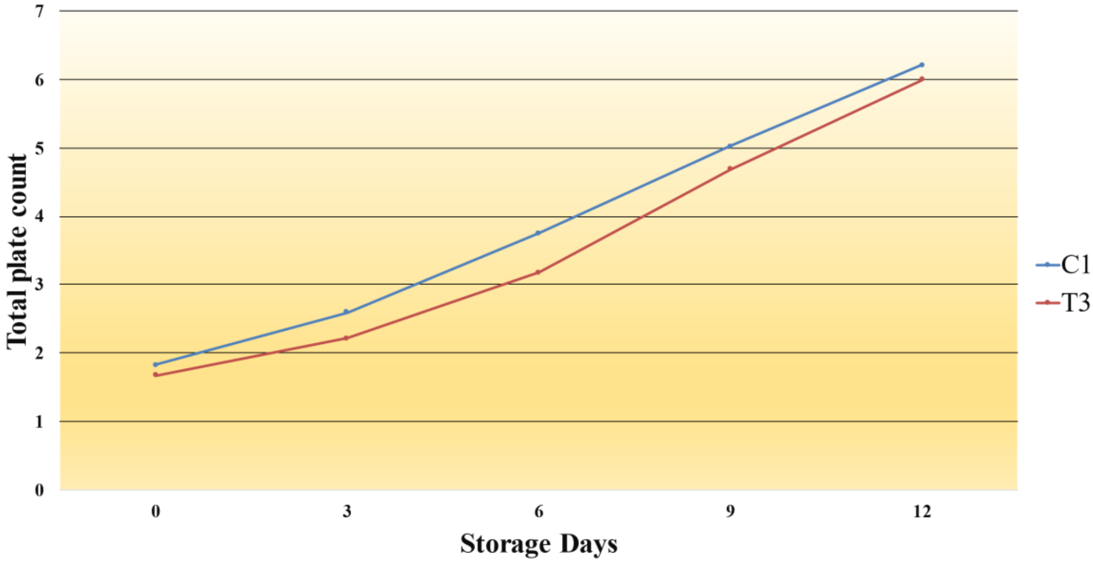
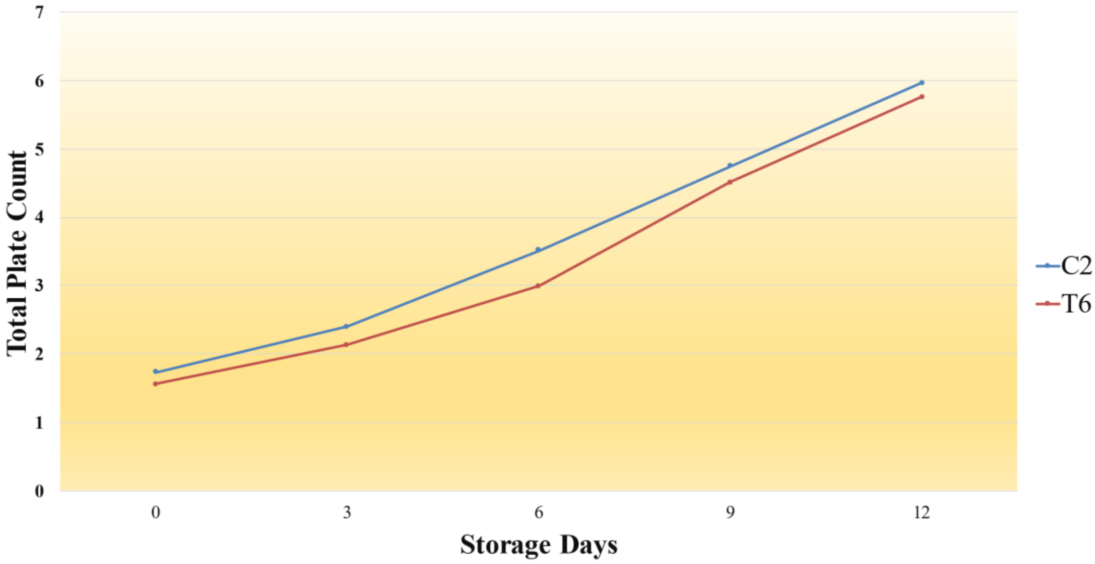


Fig 20: Total plate count values of mutton shikampuri kebab as influenced by incorporation of liquid whole egg as binder during refrigeration (4 ±1°C) storage



4.6.2.2 Yeast and Mould count

The Mean ± S.E values of yeast and mould count of both Chicken shikampuri kebabs and mutton shikampuri kebabs as influenced by addition of whole egg as binder during 12 days of refrigeration (4 ± 1°C) storage period were presented in Table 31, Table 32, Fig.21 and Fig.22 respectively and analysis of variance of the same was presented in Table 45 and Table 46 respectively.

The Mean ± S.E values of yeast and mould count of chicken shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were, 0.00, 1.53±0.06, 1.84±0.07, 2.42±0.09 and 2.92±0.07, respectively. The same values for control chicken shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 0.00, 1.78±0.07, 2.18±0.05, 2.69±0.08 and 3.07±0.09, respectively.

The overall mean yeast and mould count of control and chicken shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean yeast and mould count values of chicken shikampuri kebabs with whole egg were significantly ($P<0.05$) lower than the control and the mean yeast and mould count for both control and chicken shikampuri kebabs with whole egg were in the range of 0.00 to 2.99 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

The Mean ± S.E values of yeast and mould count of mutton shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 0.00, 1.57±0.04, 2.19±0.06, 2.57±0.07 and 3.06±0.08, respectively. The same values for control mutton shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 0.00, 1.82±0.05, 2.46±0.07, 2.87±0.09 and 3.32±0.10, respectively.

The overall mean yeast and mould count values of control and mutton shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean yeast and mould count values of mutton shikampuri kebabs were significantly ($P<0.05$) lower than the control and the mean yeast and mould count values for both control and mutton shikampuri kebabs with whole egg were in the range of 0.00 to 3.19 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

Table 31: Mean ± S.E values of yeast and mould count (*log10 CFU/g of sample*) of chicken shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C1	ND	1.78±0.07	2.18±0.05	2.69±0.08	3.07±0.09	**1.94±0.20^{x}**
T_3	ND	1.53±0.06	1.84±0.07	2.42±0.09	2.92±0.07	**1.74±0.18^{y}**
OVERALL MEAN	-	**1.65±0.05^{a}**	**2.01±0.06^{b}**	**2.56±0.07^{c}**	**2.99±0.06^{d}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C1= Chicken shikampuri kebab without egg.

T3= Chicken shikampuri kebab with whole egg.

Table 32: Mean ± S.E values of yeast and mould count (*log10 CFU/g of sample*) of mutton shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C2	ND	1.82±0.05	2. 46±0.07	2.87±0.09	3.32±0.10	**2.09 ±0.21^{x}**
T_6	ND	1.57±0.04	2.19±0.06	2. 57±0.07	3.06±0.08	**1.88±0.19^{y}**
OVERALL MEAN	-	**1.70±0.05^{a}**	**2.33±0.06^{b}**	**2.72±0.07^{c}**	**3.19±0.07^{d}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C2= Mutton shikampuri kebab without egg.

T6= Mutton shikampuri kebab with whole egg.

Fig 21: Yeast and mould count values of chicken shikampuri kebab as influenced by incorporation of liquid whole egg as binder during refrigeration (4 ±1°C) storage

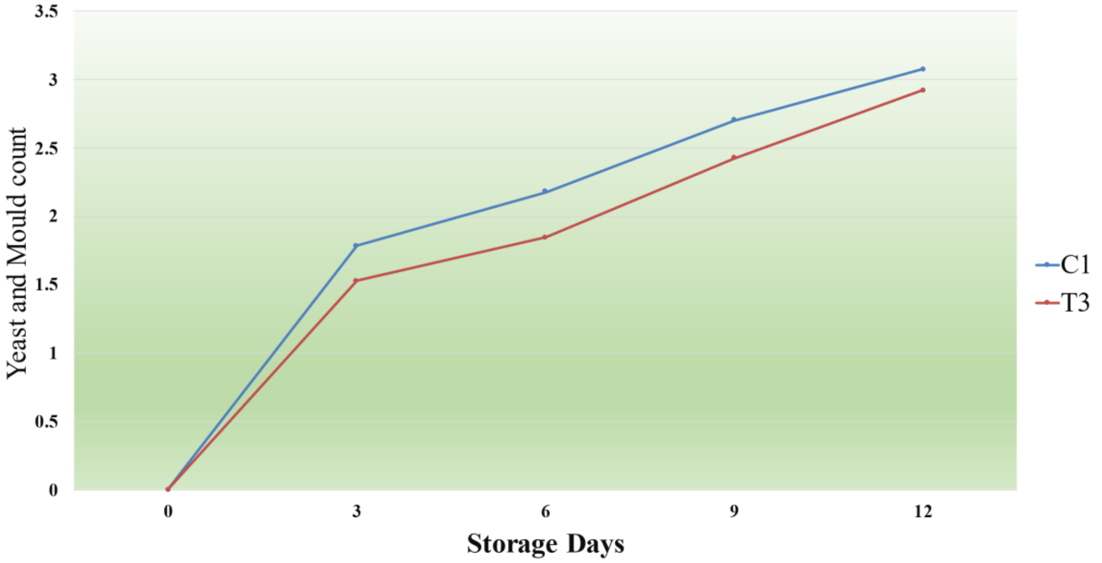
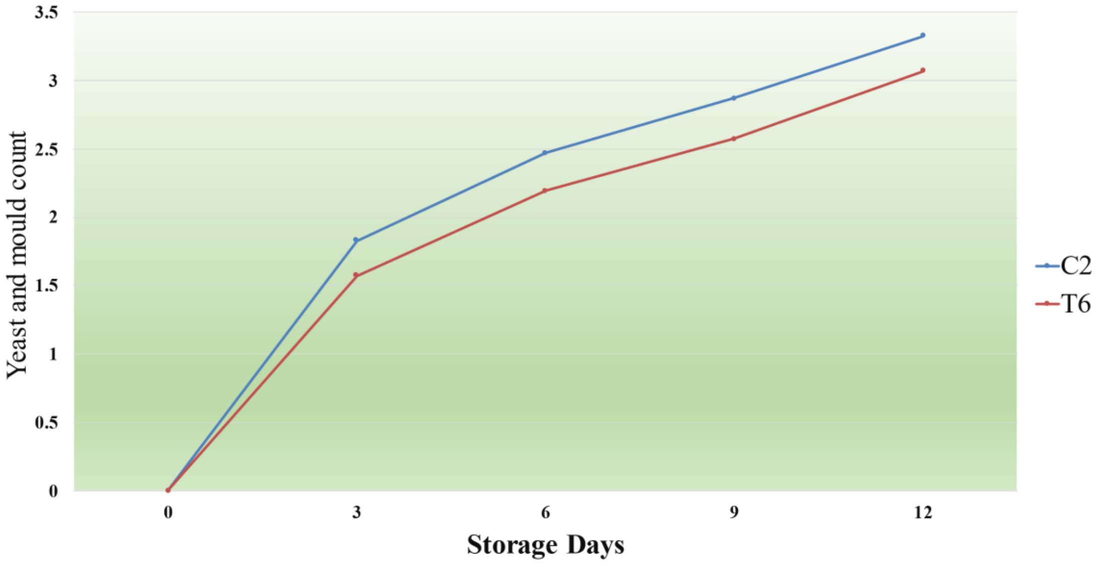


Fig 22: Yeast and mould count values of mutton shikampuri kebab as influenced by incorporation of liquid whole egg as binder during refrigeration (4 ±1°C) storage.



(a)

(b)

Plate 11: The picture both a and b showing the yeast and mold growth on the 15th day of refrigeration (4±1℃) storage period

4.6.3 Sensory Evaluation

4.6.3.1 Appearance

The Mean ± S.E values of appearance of both chicken shikampuri kebabs and mutton shikampuri kebabs as influenced by addition of whole egg as binder during 12 days of refrigeration (4 ± 1°C) storage period were presented in Table 33 and Table 34 respectively and analysis of variance of the same was presented in Table 45 and Table 46 respectively.

The Mean ± S.E values of appearance of chicken shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 7.83±0.16, 7.66±0.16, 7.41±0.20, 6.91±0.23 and 5.91±0.20, respectively. The same values for control chicken shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 6.25±021, 6.17±0.09, 5.91±0.27, 5.25±0.17 and 4.33±0.16, respectively.

The overall mean appearance of control and chicken shikampuri kebabs with whole egg were significantly (P<0.05) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean appearance values of chicken shikampuri kebabs with whole egg were significantly (P<0.05) higher than the control and the mean appearance for both control and chicken shikampuri kebabs with whole egg were in the range of 7.04 to 5.12 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

The Mean ± S.E values of appearance of mutton shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 8.08±0.15, 7.83±0.16, 7.66±0.21, 7.08±0.20 and 5.91±0.20, respectively. The same values for control mutton shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 6.33±0.10, 6.16±0.16, 6.00±0.12, 5.33±0.16 and 4.50±0.25, respectively.

The overall mean appearance values of control and mutton shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean appearance values of mutton shikampuri kebabs were significantly ($P<0.05$) higher than the control and the mean appearance values for both control and mutton shikampuri kebabs with whole egg were in the range of 7.20 to 5.20 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

Table 33: Mean ± S.E values of appearance of chicken shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C1	6.25±021	6.17±0.09	5.91±0.27	5.25±0.17	4.33±0.16	**5.58±0.15^{x}**
T_3	7.83±0.16	7.66±0.16	7.41±0.20	6.91±0.23	5.91±0.20	**7.15±0.15^{y}**
OVERALL MEAN	**7.04±0.27^{a}**	**6.92±0.24^{a}**	**6.66±0.27^{a}**	**6.08±0.28^{ab}**	**5.12±0.26^{b}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C1= Chicken shikampuri kebab without egg.

T3= Chicken shikampuri kebab with whole egg.

Table 34: Mean ± S.E values of appearance of mutton shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C2	6.33±0.10	6.16±0.16	6.00±0.12	5.33±0.16	4.50±0.25	**$5.66{\pm}0.14^{x}$**
T_6	8.08±0.15	7.83±0.16	7.66±0.21	7.08±0.20	5.91±0.20	**$7.31{\pm}0.16^{y}$**
OVERALL MEAN	**$7.20{\pm}0.27^{a}$**	**$7.00{\pm}0.27^{a}$**	**$6.83{\pm}0.27^{a}$**	**$6.20{\pm}0.29^{ab}$**	**$5.20{\pm}0.26^{b}$**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).
Mean is average of six replications.

C2= Mutton shikampuri kebab without egg.

T6= Mutton shikampuri kebab with whole egg.

4.6.3.2 Favour

The Mean ± S.E values of flavour of both Chicken shikampuri kebabs and Mutton shikampuri kebabs as influenced by addition of whole egg as binder during 12 days of refrigeration (4 ± 1°C) storage period were presented in Table 35 and Table 36 respectively and analysis of variance of the same was presented in Table 45 and Table 46 respectively.

The Mean ± S.E values of flavour of chicken shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 8.16±0.10, 7.83±0.2, 7.25±0.11, 6.91±0.15 and 5.66±0.16, respectively. The same values for control chicken shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 6.08±0.23, 6.00±0.22, 5.75±0.21, 5.16±0.10 and 4.25±0.17, respectively.

The overall mean flavour of control and chicken shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean flavour values of chicken shikampuri kebabs with whole egg were significantly ($P<0.05$) higher than the control and the mean flavour for both control and chicken shikampuri kebabs with whole egg were in the range of 7.12 to 4.95 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

The Mean ± S.E values of flavour of mutton shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 8.08±0.15, 7.75±0.21, 7.66±0.24, 7.00±0.18 and 5.75±0.21, respectively. The same values for control mutton shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 6.16±0.10, 6.00±0.18, 5.91±0.27, 5.25±0.17 and 4.41±0.20, respectively.

The overall mean flavour values of control and mutton shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean flavour values of mutton shikampuri kebabs were significantly ($P<0.05$) higher than the control and the mean flavour values for both control and mutton shikampuri kebabs with whole egg were in the range of 7.12 to 5.08 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

Table 35: Mean ± S.E values of flavour of chicken shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C1	6.08±0.23	6.00±0.22	5.75±0.21	5.16±0.10	4.25±0.17	**5.45 ± 0.15^{x}**
T_3	8.16±0.10	7.83±0.21	7.25±0.11	6.91±0.15	5.66±0.16	**7.16 ± 0.17^{y}**
OVERALL MEAN	**7.12 ± 0.33^{a}**	**6.91 ± 0.31^{a}**	**6.50 ± 0.25^{a}**	**6.04 ± 0.27^{ab}**	**4.95 ± 0.24^{b}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C1= Chicken shikampuri kebab without egg.

T3= Chicken shikampuri kebab with whole egg.

Table 36: Mean ± S.E values of flavour of mutton shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage.

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C2	6.16±0.10	6.00±0.18	5.91±0.27	5.25±0.17	4.41±0.20	**5.55±0.14^{x}**
T_6	8.08±0.15	7.75±0.21	7.66±0.24	7.00±0.18	5.75±0.21	**7.25±0.17^{y}**
OVERALL MEAN	**7.12±0.30^{a}**	**6.87±0.29^{a}**	**6.79±0.31^{a}**	**6.12±0.28^{ab}**	**5.08±0.24^{b}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C2= Mutton shikampuri kebab without egg.

T6= Mutton shikampuri kebab with whole egg.

4.6.3.3 Meat intensity flavour

The Mean ± S.E values of meat intensity flavour of both Chicken shikampuri kebabs and Mutton shikampuri kebabs as influenced by addition of whole egg as binder during 12 days of refrigeration (4 ± 1°C) storage period were presented in Table 37 and Table 38 respectively and analysis of variance of the same was presented in Table 45 and Table 46 respectively.

The Mean ± S.E values of meat intensity flavour of chicken shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 7.66±0.10, 7.41±0.15, 7.00±0.22, 6.33 ±0.16 and 5.50±0.18, respectively. The same values for control chicken shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 7.66±0.10, 7.41±0.15, 7.08±0.30, 6.66±0.10 and 5.58±0.20, respectively.

The overall mean meat intensity flavour of control and chicken shikampuri kebabs with whole egg were significantly (P<0.05) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean meat intensity flavour values of chicken shikampuri kebabs with whole egg were significantly (P<0.05) lower than the control and the mean meat intensity flavour for both control and chicken shikampuri kebabs with whole egg were in the range of 7.66 to 5.54 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

The Mean ± S.E values of meat intensity flavour of mutton shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 7.58±0.15, 7.50±0.12, 7.00±0.12, 6.41±0.15 and 5.33±0.16, respectively. The same values for control mutton shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4

± 1°C) temperature were 7.66±0.21, 7.41±0.15, 7.16±0.24, 6.41 ±0.15 and 5.41±0.20, respectively.

The overall mean meat intensity flavour values of control and mutton shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean meat intensity flavour values of mutton shikampuri kebabs were significantly ($P<0.05$) lower than the control and the mean meat intensity flavour values for both control and mutton shikampuri kebabs with whole egg were in the range of 7.62 to 5.37 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

Table 37: Mean ± S.E values of meat intensity flavour of chicken shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage.

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C1	7.66±0.10	7.41±0.15	7.08±0.30	6.66±0.10	5.58±0.20	**6.86±0.16^{x}**
T_3	7.66±0.10	7.41±0.15	7.00±0.22	6.33 ±0.16	5.50±0.18	**6.80±0.15^{x}**
OVERALL MEAN	**7.66±0.07^{a}**	**7.41±0.10^{ab}**	**7.04±0.17^{b}**	**6.50±0.10^{c}**	**5.54±0.12^{d}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C1= Chicken shikampuri kebab without egg.

T3= Chicken shikampuri kebab with whole egg.

Table 38: Mean ± S.E values of meat intensity flavour of mutton shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C2	7.66±0.21	7.41±0.15	7.16±0.24	6.41 ±0.15	5.41±0.20	**6.81±0.17^{x}**
T_6	7.58±0.15	7.50±0.12	7.00±0.12	6.41±0.15	5.33±0.16	**6.76±0.16^{x}**
OVERALL MEAN	**7.62±0.12^{a}**	**7.45±0.09^{ab}**	**7.08±0.13^{b}**	**6.41±0.10^{c}**	**5.37±0.12^{d}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C2= Mutton shikampuri kebab without egg.

T6= Mutton shikampuri kebab with whole egg.

4.6.3.4 Juiciness

The Mean ± S.E values of juiciness of both Chicken shikampuri kebabs and Mutton shikampuri kebabs as influenced by addition of whole egg as binder during 12 days of refrigeration (4 ± 1°C) storage period were presented in Table 39 and Table 40 respectively and analysis of variance of the same was presented in Table 45 and Table 46 respectively.

The Mean ± S.E values of juiciness of chicken shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 7.91±0.15, 7.58±0.15, 7.00±0.25, 6.83±0.21 and 5.75±0.25, respectively. The same values for control chicken shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 6.91±0.15, 6.50±0.25, 6.25±0.11, 6.16±0.16 and 5.16±0.10, respectively.

The overall mean juiciness of control and chicken shikampuri kebabs with whole egg were significantly (P<0.05) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean juiciness values of chicken shikampuri kebabs with whole egg were significantly (P<0.05) higher than the control and the mean juiciness for both control and chicken shikampuri kebabs with whole egg were in the range of 7.41 to5.45 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

The Mean ± S.E values of juiciness of mutton shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 8.16±0.10, 7.83±0.16, 7.50±0.18, 6.91±0.15 and 5.83±0.16, respectively. The same values for control mutton shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 7.08±0.15, 6.91±0.20, 6.75±0.17, 6.00±0.25 and 5.16±0.10, respectively.

The overall mean juiciness values of control and mutton shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean juiciness values of mutton shikampuri kebabs were significantly ($P<0.05$) higher than the control and the mean juiciness values for both control and mutton shikampuri kebabs with whole egg were in the range of 7.62 to 5.50 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

Table 39: Mean ± S.E values of juiciness of chicken shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C1	6.91±0.15	6.50±0.25	6.25±0.11	6.16±0.16	5.16±0.10	**6.20 ± 0.12^{x}**
T_3	7.91±0.15	7.58±0.15	7.00±0.25	6.83±0.21	5.75±0.25	**7.01 ± 0.16^{y}**
OVERALL MEAN	**7.41 ± 0.18^{a}**	**7.04 ± 0.21^{ab}**	**6.62 ± 0.17^{b}**	**6.50 ± 0.16^{b}**	**5.45 ± 0.15^{c}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C1= Chicken shikampuri kebab without egg.

T3= Chicken shikampuri kebab with whole egg.

Table 40: Mean ± S.E values of juiciness of mutton shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C2	7.08±0.15	6.91±0.20	6.75±0.17	6.00±0.25	5.16±0.10	**6.38 ± 0.15^{x}**
T_6	8.16±0.10	7.83±0.16	7.50±0.18	6.91±0.15	5.83±0.16	**7.25 ± 0.16^{y}**
OVERALL MEAN	**7.62 ± 0.18^{a}**	**7.37 ± 0.18^{a}**	**7.12 ± 0.16^{ab}**	**6.45 ± 0.19^{b}**	**5.50 ± 0.13^{c}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C2= Mutton shikampuri kebab without egg.

T6= Mutton shikampuri kebab with whole egg.

4.6.3.5 Texture

The Mean ± S.E values of texture of both Chicken shikampuri kebabs and Mutton shikampuri kebabs as influenced by addition of whole egg as binder during 12 days of refrigeration (4 ± 1°C) storage period were presented in Table 41 and Table 42 respectively and analysis of variance of the same was presented in Table 45 and Table 46 respectively.

The Mean ± S.E values of texture of chicken shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 8.16±0.10, 7.83±0.16, 7.66±0.21, 6.91±0.23 and 5.83±0.24, respectively. The same values for control chicken shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 6.16±0.10, 6.00±0.12, 5.66±0.24 and 5.16±0.10 and 4.41±0.20, respectively.

The overall mean texture of control and chicken shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean texture values of chicken shikampuri kebabs with whole egg were significantly ($P<0.05$) higher than the control and the mean texture for both control and chicken shikampuri kebabs with whole egg were in the range of 7.16 to 5.12 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

The Mean ± S.E values of texture of mutton shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 8.16±0.16, 7.75±0.21, 7.58±0.20, 6.83±0.27 and 5.66±0.16, respectively. The same values for control mutton shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 6.25±0.11, 6.16±0.10, 6.08±0.23, 5.41±0.20 and 4.41±0.20 respectively.

The overall mean texture values of control and mutton shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean texture values of mutton shikampuri kebabs were significantly ($P<0.05$) higher than the control and the mean texture values for both control and mutton shikampuri kebabs with whole egg were in the range of 7.20 to 5.04 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

Table 41: Mean ± S.E values of texture of chicken shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C1	6.16±0.10	6.00±0.12	5.66±0.24	5.16±0.10	4.41±0.20	**5.48±0.13^{x}**
T_3	8.16±0.10	7.83±0.16	7.66±0.21	6.91±0.23	5.83±0.24	**7.01±0.16^{y}**
OVERALL MEAN	**7.16±0.30^{a}**	**6.91±0.29^{a}**	**6.66±0.33^{a}**	**6.04±0.29^{ab}**	**5.12±0.26^{b}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C1= Chicken shikampuri kebab without egg.

T3= Chicken shikampuri kebab with whole egg.

Table 42: Mean ± S.E values of texture of mutton shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C2	6.25±0.11	6.16±0.10	6.08±0.23	5.41±0.20	4.41±0.20	**5.66±0.14^{x}**
T_6	8.16±0.16	7.75±0.21	7.58±0.20	6.83±0.27	5.66±0.16	**7.20±0.18^{y}**
OVERALL MEAN	**7.20±0.30^{a}**	**6.95±0.26^{ab}**	**6.83±0.27^{ab}**	**6.12±0.26^{b}**	**5.04±0.22^{c}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C2= Mutton shikampuri kebab without egg.

T6= Mutton shikampuri kebab with whole egg.

4.6.3.6 Overall acceptability

The Mean ± S.E values of overall acceptability of both Chicken shikampuri kebabs and Mutton shikampuri kebabs as influenced by addition of whole egg as binder during 12 days of refrigeration (4 ± 1°C) storage period were presented in Table 43, Table 44, Fig.23 and Fig.24 respectively and analysis of variance of the same was presented in Table 45 and Table 46 respectively.

The Mean ± S.E values of overall acceptability of chicken shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 8.16±0.10, 7.91±0.20, 7.66±0.21, 7.00±0.18 and 5.91±0.20, respectively. The same values for control chicken shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 7.16±0.10, 7.00±0.12, 6.75±0.25, 6.41±0.15 and 5.50±0.18, respectively.

The overall mean overall acceptability of control and chicken shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean overall acceptability values of chicken shikampuri kebabs with whole egg were significantly ($P<0.05$) higher than the control and the mean overall acceptability for both control and chicken shikampuri kebabs with whole egg were in the range of 7.66 to 5.70 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

The Mean ± S.E values of overall acceptability of mutton shikampuri kebabs with whole egg at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were 8.25±0.11, 8.16±0.10, 7.50±0.18, 6.83±0.21 and 5.91±0.27, respectively. The same values for control mutton shikampuri kebabs at 0, 3, 6, 9 and 12 days of refrigeration (4 ± 1°C) temperature were, 7.08±0.08, 6.75±0.17, 6.50±0.18, 6.08±0.15 and 5.08±0.15, respectively.

The overall mean overall acceptability values of control and mutton shikampuri kebabs with whole egg were significantly ($P<0.05$) affected by storage period at refrigerated (4 ± 1°C) storage condition.

The overall mean overall acceptability values of mutton shikampuri kebabs were significantly ($P<0.05$) higher than the control and the mean overall acceptability values for both control and mutton shikampuri kebabs with whole egg were in the range of 7.66 to 5.50 which were well within the limits during the refrigeration (4 ± 1°C) storage period.

Table 43: Mean ± S.E values of overall acceptability of chicken shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C1	7.16±0.10	7.00±0.12	6.75±0.25	6.41±0.15	5.50±0.18	**6.56±0.13^{x}**
T_3	8.16±0.10	7.91±0.20	7.66±0.21	7.00±0.18	5.91±0.20	**7.33±0.16^{y}**
OVERALL MEAN	**7.66±0.16^{a}**	**7.45±0.17^{a}**	**7.20±0.20^{ab}**	**6.70±0.14^{b}**	**5.70±0.14^{c}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C1= Chicken shikampuri kebab without egg.

T3= Chicken shikampuri kebab with whole egg.

Table 44: Mean ± S.E values of overall acceptability of mutton shikampuri kebab as influenced by incorporation of whole egg as binder during refrigeration (4 ± 1°C) storage

TREATMENTS	DAYS OF STORAGE					OVERALL MEAN
	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12	
C2	7.08±0.08	6.75±0.17	6.50±0.18	6.08±0.15	5.08±0.15	**6.30 ± 0.14^{x}**
T_6	8.25±0.11	8.16±0.10	7.50±0.18	6.83±0.21	5.91±0.27	**7.33 ± 0.17^{y}**
OVERALL MEAN	**7.66 ± 0.18^{a}**	**7.45 ± 0.23^{a}**	**7.00 ± 0.19^{ab}**	**6.45 ± 0.16^{b}**	**5.50 ± 0.19^{c}**	

Note: Means bearing different superscripts with in a row and column wise differ significantly (P<0.05).

Mean is average of six replications.

C2= Mutton shikampuri kebab without egg.

T6= Mutton shikampuri kebab with whole egg.

Fig 23: Overall acceptability values of chicken shikampuri kebab as influenced by incorporation of liquid whole egg as binder during refrigeration (4 ±1°C) storage

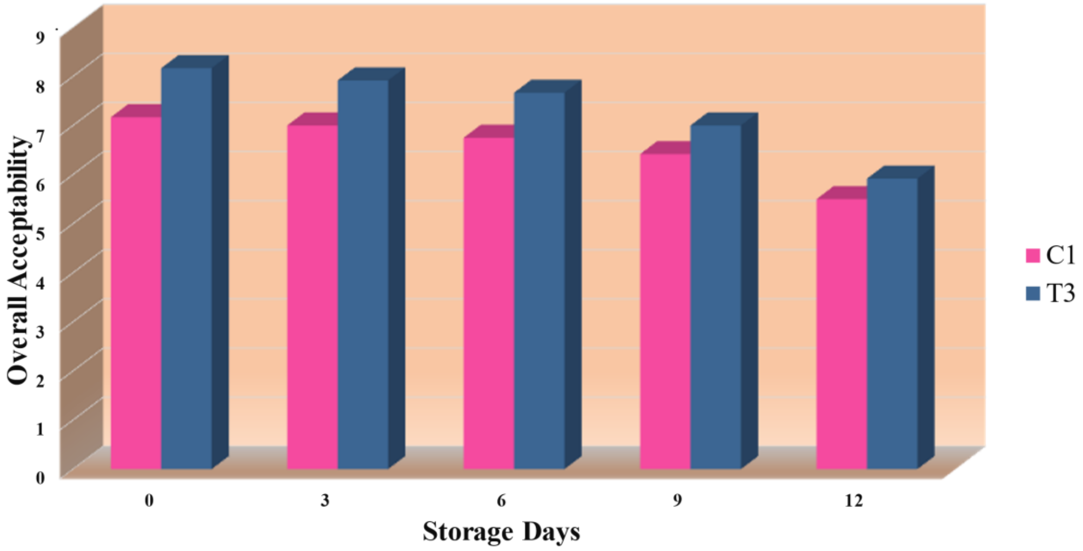


Fig 24: Overall acceptability values of mutton shikampuri kebab as influenced by incorporation of liquid whole egg as binder during refrigeration (4 ±1°C) storage

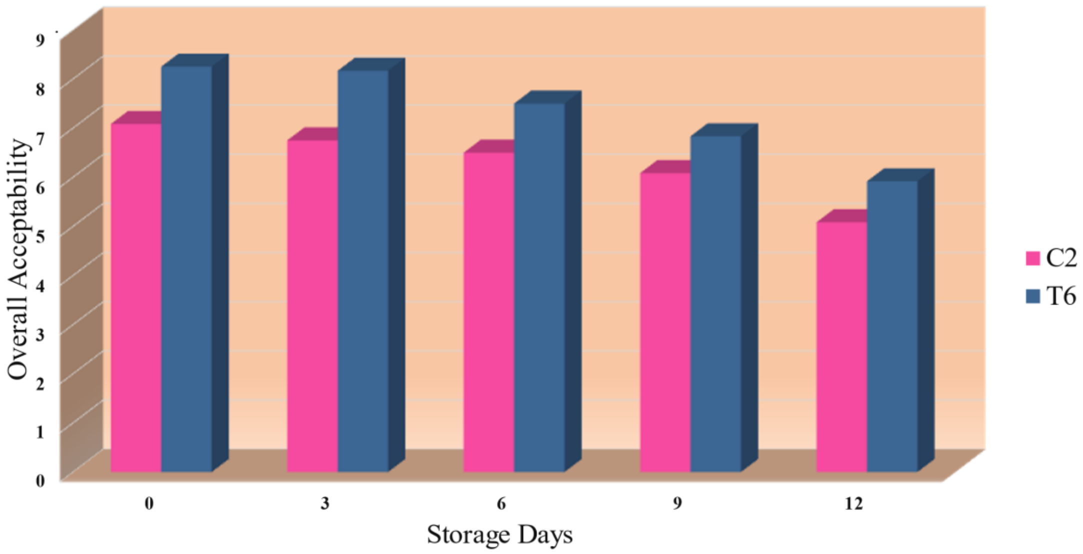


Table 45: Analysis (paired samples T test) of physico-chemical characteristics, microbiological and sensory evaluation of chicken shikampuri kebab as influenced by whole egg as binder during refrigerated (4 ± 1℃) storage.

Parameters	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
pH	-.09233	.07074	.01292	-.11875	-.06592	-7.149	29	.000**
Batter stability	-2.47767	.92379	.16866	-2.82261	-2.13272	-14.690	29	.000*
TBARS	-.05533	.05198	.00949	-.07474	-.03592	-5.831	29	.000*
Tyrosine	-.05600	.04039	.00738	-.07108	-.04092	-7.593	29	.000*
Total plate count	.33200	.20919	.03819	.25389	.41011	8.693	29	.000*
Yeast and mould count	.20333	.23085	.04215	.11713	.28953	4.824	29	.000*
Appearance	-1.56500	.70821	.12930	-1.82945	-1.30055	-12.104	29	.000*
Flavour	-1.71667	.69087	.12613	-1.97464	-1.45869	-13.610	29	.000*
Meat intensity flavour	.10000	.57834	.10559	-.11596	.31596	.947	29	.351^{NS}
Juiciness	-.81667	.63631	.11617	-1.05427	-.57907	-7.030	29	.000*
Texture	-1.80000	.68983	.12594	-2.05759	-1.54241	-14.292	29	.000*
Overall acceptability	-.76667	.66609	.12161	-1.01539	-.51794	-6.304	29	.000*

***means significant (P<0.05), NS - non significant**

Table 46: Analysis (paired samples T test) of physico-chemical characteristics, microbiological and sensory evaluation of mutton shikampuri kebab as influenced by whole egg as binder during refrigerated (4 ± 1℃) storage.

Parameters	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
pH	-.09233	.07074	.01292	-.11875	-.06592	-7.149	29	.000*
Batter stability	-5.39433	.99508	.18168	-5.76590	-5.02276	-29.692	29	.000*
TBARS	-.06167	.04332	.00791	-.07784	-.04549	-7.797	29	.000*
Tyrosine	-.06500	.12708	.02320	-.11245	-.01755	-2.801	29	.009
TPC	.28000	.18588	.03394	.21059	.34941	8.251	29	.000*
Yeast and mould count	.21633	.17659	.03224	.15040	.28227	6.710	29	.000*
Appearance	-1.65000	.52768	.09634	-1.84704	-1.45296	-17.127	29	.000*
Flavour	-1.70000	.62422	.11397	-1.93309	-1.46691	-14.917	29	.000*
Meat intensity flavour	.05000	.40151	.07330	-.09992	.19992	.682	29	.501^{NS}
Juiciness	-.86667	.61495	.11227	-1.09629	-.63704	-7.719	29	.000*
Texture	-1.53333	.60077	.10968	-1.75766	-1.30900	-13.980	29	.000*
Overall acceptability	-1.03333	.50742	.09264	-1.22281	-.84386	-11.154	29	.000*

***means significant (P<0.05), NS - non significant**

Chapter – V

DISCUSSION

CHAPTER V
DISCUSSION

The present chapter discusses the results obtained from the different studies carried out during the present investigation in accordance ·with the objectives given in the chapter one, following the methods described in the preceding chapters. The results have been presented through narration and critically discussed and reviewed in the light of objectives.

The royal cuisine of Hyderabad is famous for its variety of kebabs and other meat dishes. Kebabs are usually associated with the advent of the mughals in India. The mughals love for meat blended with the fiery spices of Andhra Pradesh which led to the creation of some of the best kebabs and other meat dishes of India. Shikampuri kebabs of Hyderabad is also one such kebabs recipe which hails from the royal kitchens of the nizam.

Standardizing the procedure of preparation of such ethnic and wide popular Hyderabadi meat product helps traditional and health-conscious consumers to enjoy the traditional delicacy and also documentation of specific methodology for preparation of the shikampuri kebabs is possible.

This research was aimed at bringing in forth the traditional standard taste of shikampuri kebabs to the consumers. The experiment was conducted in different phases. Initially the product was standardized as per the traditional process of preparation. Later, attempts were made to enhance the quality of the product with use of chicken and mutton with liquid egg as binder. The preparations were evaluated for their quality and shelf- life was determined.

5.1 SENSORY QUALITY EVALUATION OF SHIKAMPURI KEBABS AS INFLUENCED BY DIFFERENT LEVELS OF ADDITION OF LIQUID EGG COMPONENTS AS BINDER.

Different formulations were prepared by incorporating egg albumen, egg yolk and whole egg, separately at three different levels (5%, 7.5%, 10%) in the basic formulation of shikampuri kebabs. Among different levels, 10% incorporation level of all the three binders (egg albumen, egg yolk, whole egg) scored significantly higher for all the sensory parameters in both chicken and mutton shikampuri kebabs and thus 10% level of incorporation of binders were selected for further study. Findings of the present study are similar to those of Kumar *et al*. (2010) prepared chevon patties using egg albumen liquid as binder at 5%, 10% and 15% level of inclusion and stated that 10% level of egg albumen liquid was found to be best suited level. Adzitey *et al.* (2016) used whole guinea fowl egg as binder in beef and chevon burgers and stated that the burgers with highest inclusion level (9%) were preferred most.

5.2 QUALITY EVALUATION OF SHIKAMPURI KEBABS AS INFLUENCED BY ADDITION OF DIFFERENT COMPONENTS OF LIQUID EGG AS BINDER.

Egg albumen, egg yolk and whole egg as binders at the level of 10% were used in the development of the shikampuri kebabs with both mutton and chicken. Different treatments like chicken shikampuri kebabs without egg as C1, chicken shikampuri kebabs with egg albumen as T1, chicken shikampuri kebabs with egg yolk as T2 and chicken shikampuri kebabs with whole egg as T3 and mutton without egg as control C2, mutton with egg albumen as T4, mutton with egg yolk as T5 and mutton with whole egg as T6. The developed treatments were evaluated for various physico-chemical and sensory characteristics.

5.3 PHYSICO - CHEMICAL CHARACTERISTICS

5.3.1 pH

The pH depends on the concentration of free H+ ion and indicates the changes in total organic acids. The free state of H+ ions is due to dissociation of H+ ions from the carboxylic group (-COOH) of organic acid (Wills *et al.* 1998).

The mean pH values of chicken shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed non significantly ($P>0.05$) between treatments and as well as with control.

The mean pH values of mutton shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed non significantly ($P>0.05$) between treatments and as well as with control.

Findings of present study are similar to those of Kalaikannan (1998) who also reported nonsignificant effect on pH with addition of 1 to 3 percent of dried albumen. Kalaikannnan *et al.* (2007) also reported non-significant effect on pH with addition of whole egg powder, dried albumen, dried yolk at a 1% level and liquid egg at a 3.7% level in chicken patties. Suradkar *et al.* (2012) also reported that non-significant effect on pH with addition of whole egg liquid in chicken nuggets at the level of 10%, 15%, 20%.

5.3.2 Cooking yield (%)

Cooking yield is one of the important parameter in the preparation of products. It describes the changes in the product cooked weight due to moisture loss. This can be attributed to moisture evaporation, water absorption or fat losses.

The mean cooking yield values of chicken shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly ($P<0.05$) between treatments and as well as with control. The chicken shikampuri kebabs incorporated with whole egg (T3) had significantly (P<0.05) higher mean cooking yield values than the rest of the treatments and control.

The mean cooking yield values of mutton shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly (P<0.05) between treatments and as well as with control. The mutton shikampuri kebabs incorporated with whole egg (T6) had significantly (P<0.05) higher mean cooking yield values than the rest of the treatments and control.

The increase in cooking yield might be due to the high-water retention in the meat matrix and better emulsification and binding of moisture and fat by the lecithin provided by the liquid whole egg. This statement is in well agreement with Padda *et al.* (1988). The incorporation of whole egg liquid improved the product yield by retaining more water and fat during cooking. Pati *et al.* (1992) also reported similar effects of liquid whole egg on the cooking loss of patties from buffalo meat. Gujral *et al.* (2002) reported reduced cooking losses on addition of 10% of liquid whole egg to the patties. Kumar and Sharma (2005) found significantly (p<0.01) higher cooking yield of chicken patties extended with 5%, 10% and 15% sorghum flour as compared with control patties. Sudha *et al*. (2008) reported that there was highly significant (p<0.01) improvement in product yield of pork patties incorporated with whole egg liquid when compared to control.

5.4 PROXIMATE COMPOSITION

5.4.1 Percent moisture

The mean percent moisture values of chicken shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly ($P<0.05$) between treatments and as well as with control. The chicken shikampuri kebabs incorporated with egg albumen (T1) had significantly ($P<0.05$) higher mean percent moisture values than the rest of the treatments and control. The increase in moisture content might be due to higher moisture retention and water binding property of egg albumen.

The mean percent moisture values of mutton shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly ($P<0.05$) between treatments and as well as with control. The mutton shikampuri kebabs incorporated with egg albumen (T4) had significantly ($P<0.05$) higher mean percent moisture values than the rest of the treatments and control. The increase in moisture content might be due to higher moisture retention and water binding property of egg albumen.

Findings of present study are similar to those of Sudha *et al.* (2008) also reported increase in moisture content of pork patties prepared by using different levels of whole egg as binder. Ossom *et al.* (2016) reported the moisture content of beef burger prepared using different levels of egg albumen were significantly ($P<0.05$) higher than the control.

5.4.2 Percent fat

The mean percent fat values of chicken shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly ($P<0.05$) between treatments and as well as with control. The chicken shikampuri kebabs incorporated with egg yolk (T2) had significantly ($P<0.05$) higher mean percent fat values than the rest of the treatments and control. The increase in fat content might be due to more fat content and fat-soluble vitamins are mainly concentrated in the egg yolk when compared to albumen and control and also eggs are very rich source of essential fatty acids. (Orr and Fletcher 1975).

The mean percent fat values of mutton shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly ($P<0.05$) between treatments and as well as with control. The mutton shikampuri kebabs incorporated with egg yolk (T5) had significantly ($P<0.05$) higher mean percent fat values than the rest of the treatments and control. The increase in fat content might be due to more fat content and fat-soluble vitamins are mainly concentrated in the egg yolk when compared to albumen and control. (Orr and Fletcher 1975).

5.4.3 Percent protein

The mean percent protein values of chicken shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed non significantly ($P<0.05$) between treatments and differed significantly ($P<0.05$) with control. The chicken shikampuri kebabs incorporated with egg yolk (T2) had significantly ($P<0.05$) higher mean percent protein values than the rest of the treatments and control. The increase in protein content might be due to more protein content in egg yolk when compared to albumen and control.

The mean percent protein values of mutton shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed non significantly ($P<0.05$) between treatments and differed significantly ($P<0.05$) with control. The mutton shikampuri kebabs incorporated with egg yolk (T5) had significantly ($P<0.05$) higher mean percent protein values than the rest of the treatments and control. The increase in protein content might be due to more protein content in egg yolk when compared to albumen and control. (Romanoff AL and Romanoff AJ 1949).

5.4.4 Total ash

The mean total ash values of chicken shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed non significantly (P>0.05) between treatments and differed significantly (P<0.05) with control. The chicken shikampuri kebabs incorporated with egg yolk (T2) had significantly (P<0.05) higher mean total ash values than the rest of the treatments and control. The increase in ash content might be due to high mineral content in egg yolk when compared to albumen and control.

The mean percent ash values of mutton shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed non significantly (P>0.05) between treatments and differed significantly (P<0.05) with control. The mutton shikampuri kebabs incorporated with egg yolk (T5) had significantly (P<0.05) higher mean total ash values than the rest of the treatments and control. The increase in ash content might be due to high mineral content in egg yolk when compared to albumen and control.

The findings are in accordance with those of Gupta *et al.* (1993) who also observed significant increase (P<0.05) in the ash percentage of fat in chicken nuggets.

5.5 SENSORY EVALUATION

5.5.1 Appearance

The appearance is one of the important physical properties in determining consumer acceptance of the product.

The mean appearance scores of chicken shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly (P<0.05) between treatments and as well as with control. The chicken shikampuri kebabs incorporated with whole egg (T3) had significantly (P<0.05) higher mean appearance values than the rest of the treatments and control. This might be due to the shikampuri kebabs attained proper shape due to the binding property of egg in the product and gives better appearance to the product.

The mean appearance scores of mutton shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly (P<0.05) between treatments and as well as with control. The mutton shikampuri kebabs incorporated with whole egg (T6) had significantly (P<0.05) higher mean appearance values than the rest of the treatments and control. This might be due to the shikampuri kebabs attained proper shape due to the binding property of egg in the product and gives better appearance to the product.

Present findings of study are in accordance with the observations of Kondaiah and Panda (1989) and Gupta (1990). Similar findings was observed by Suradkar *et al*. (2012) by addition of whole egg liquid in chicken nuggets has significantly (P<0.05) higher scores for appearance when compared to control.

5.5.2 Flavour

Flavour was important both in terms of aesthetic appearance and also for improving the secretion of digestive juices

The mean flavour scores of chicken shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly (P<0.05) between treatments and as well as with control. The chicken shikampuri kebabs incorporated with whole egg (T3) had significantly (P<0.05) higher mean flavour values than the rest of the treatments and control. This might be due to the higher retention of fat and moisture in whole egg added Kebabs and gives better flavour to the product.

The mean flavour scores of mutton shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly (P<0.05) between treatments and as well as with control. The mutton shikampuri kebabs incorporated with whole egg (T6) had significantly ($P<0.05$) higher mean flavour values than the rest of the treatments and control. This might be due to the higher retention of fat and moisture in whole egg added kebabs and gives better flavour to the product.

Similar findings in accordance with the obsevations of Gupta *et al*. (1993) who also reported that the incorporation of whole egg liquid in mutton and mutton plus chicken sausages increased the flavour scores considerably. In contrast Suradkar *et al.* (2012) reported a non-significant ($P>0.05$) effect of bread crumbs on the colour and flavour scores of chicken nuggets and Verma *et al.* (2013) in mutton nuggets on inclusion of guava powder**.**

5.5.3 Meat intensity flavour

The mean meat intensity flavour scores of chicken shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed non significantly ($P>0.05$) between treatments and non-significantly higher in control. The chicken shikampuri kebabs incorporated with whole egg (T3) had non significantly ($P>0.05$) higher mean meat intensity flavour values than the rest of the treatments.

The mean meat intensity flavour scores of mutton shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed non significantly ($P>0.05$) between treatments and significantly higher control. The mutton shikampuri kebabs incorporated with whole egg (T6) had non significantly ($P>0.05$) higher mean meat intensity flavour values than the rest of the treatments.

The findings are in accordance with Mishra *et al*. (2015) stated that the meat intensity flavour was non significantly higher in control product when compared to the extended chicken ring.

5.5.4 Juiciness

The mean juiciness scores of chicken shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed non significantly (P>0.05) between treatments and as well as with control. The chicken shikampuri kebabs incorporated with whole egg (T3) had non significantly (P>0.05) higher mean juiciness values than the rest of the treatments and control.

The mean appearance scores of mutton shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed non significantly (P>0.05) between treatments and as well as with control. The mutton shikampuri kebabs incorporated with whole egg (T6) had non significantly (P>0.05) higher mean juiciness values than the rest of the treatments and control.

Findings of the present study are similar to those of (Serdaroglu and Ozsumer, 2003). The increase in moisture levels might be resulting in increased juiciness of the product. Martina (2017) reported that there was no significant difference in juiciness of chicken cutlets of control as well as those incorporated with different levels of whole egg liquid.

5.5.5 Texture

The mean texture scores of chicken shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly (P<0.05) between treatments and as well as with control. The chicken shikampuri kebabs incorporated with whole egg (T3) had significantly (P<0.05) higher mean texture values than the rest of the treatments and control. This might be due to improved softness due to the retention of moisture gives better texture to the product.

The mean appearance scores of mutton shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly (P<0.05) between treatments and as well as with control. The mutton shikampuri kebabs incorporated with whole egg (T6) had significantly (P<0.05) higher mean texture values than the rest of the treatments and control. This might be due to improved softness due to the retention of moisture gives better texture to the product.

It has been reported that egg white protein contributes to textural modification in salami (Burgarella *et al,* 1985). Carballo *et al*. (1996) also reported better response for flavour, texture and juiciness in bologna sausages with incorporation of egg white. Verma *et al*. (2012) reported the textural scores differed significantly (P<0.05) in chicken sausages due to the incorporation of different levels of whole egg powder than the control.

5.5.6 Overall acceptability

Overall acceptability is not an independent sensory attribute as it gives the mixed feeling of acceptance based on colour, flavour, juiciness and tenderness. The mean overall acceptability scores of chicken shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly (P<0.05) between treatments. chicken shikampuri kebabs prepared with incorporating whole egg (T3) revealed better overall acceptability score than the other treatments and control.

The mean overall acceptability scores of mutton shikampuri kebabs incorporated with egg albumen, egg yolk and whole egg differed significantly (P<0.05) between treatments. Mutton shikampuri kebabs prepared with incorporating whole egg (T6) revealed better overall acceptability score than the other treatments and control.

Anjaneyulu *et al*. (1990) reported significant quality improvement in buffalo meat patties with the incorporation of liquid whole egg. The results were in accordance with Modi *et al.* (2009) in mutton kofta incorporated with carrageenan. Hazra *et al.* (2012) in ground buffalo meat with drumstick leaves extract and

Based on the above result, chicken shikampuri kebabs prepared with whole egg (T3) and mutton shikampuri kebabs with whole egg (T6) had significantly higher ($P<0.05$) cooking yield and better sensory scores than control and remaining formulations, thus those were selected for further storage studies.

5.6 EVALUATION OF STORAGE STABILITY OF BOTH MUTTON AND CHICKEN SHIKAMPURI KEBABS BY ADDITION OF LIQUID WHOLE EGG AS BINDER.

Chicken shikampuri kebabs incorporating with whole egg (T3) and control chicken shikampuri kebabs without egg (C1) and mutton shikampuri kebabs incorporating with whole egg (T6) and control mutton shikampuri kebabs without egg (C2) formulations were packaged in LDPE pouches under aerobic packaging and subjected to shelf-life studies under refrigeration (4 ± 1°C) temperature and evaluated at 2 days interval till spoilage.

5.6.1 Physico - chemical characteristics

5.6.1.1 pH

There was non-significant difference ($P>0.05$) found between the pH values of chicken shikampuri kebabs with incorporation of whole egg (T3) and control kebabs. chicken shikampuri kebabs with whole egg (T3) had non significantly ($P<0.05$) higher pH values than control throughout the refrigerated (4 ± 1°C) storage period.

During refrigerated (4±1°C) storage, the mean pH values of chicken shikampuri kebabs (T3) and control increased non significantly (P>0.05) up to the 6th day then after increased significantly (P<0.05) with advancement of storage period.

There was non-significant difference (P>0.05) found between the pH values of mutton shikampuri kebabs with incorporation of whole egg (T6) and control kebabs. Mutton shikampuri kebabs with whole egg (T6) had non significantly (P>0.05) higher pH values than control throughout the refrigerated (4 ± 1°C) storage period.

Similar results were observed by Kalaikannnan *et al*. (2007) in chicken patties with whole egg powder, dried albumen and dried yolk at different levels under refrigerated (4±1°C) storage.

During refrigerated (4±1°C) storage, the mean pH values of mutton shikampuri kebabs (T6) and control increased non significantly (P>0.05) up to the 6th day then after increased significantly (P<0.05) with increasing storage period.

This might be due to the accumulation of metabolites by the action of bacteria (Jay, 1996) in addition to protein and amino acid degradation resulting in formation of ammonia which might have lead to consequent increase in pH (Nagamallika *et al.*, 2006).

These results are in agreement with Nag *et al.* (1998) also observed a gradual increase in pH of LDPE packed extended chicken nuggets stored at refrigerated (4±1°C). temperature. Further, Sunki *et al*. (1978), Murthy and Bachhil (1980), Prabhakara and Satyanarayana (1990) Bhat *et al*. (2012) have also reported a progressive increase in pH of refrigerated storage meat products. Kandeepan and Biswas (2007) reported gradual increase in pH was observed in chiller and freezer stored meat and revealed pH increased with increasing storage period.

5.6.1.2 Batter stability (%)

There was significant difference ($P<0.05$) found between the batter stability values of chicken shikampuri kebabs with incorporation of whole egg (T3) and control kebabs. Chicken shikampuri kebabs with whole egg (T3) had significantly ($P<0.05$) higher batter stability values than control throughout the refrigerated (4±1°C) storage period. The significantly ($P<0.05$) higher batter stability values in chicken shikampuri kebabs with whole egg (T3) could be attributed to the better emulsification and binding of moisture and fat by the lecithin provided by the liquid whole egg.

During refrigerated (4±1°C) storage, the mean batter stability values of chicken shikampuri kebabs with whole egg (T3) and control increased non significantly ($P>0.05$) with the advancement of storage period.

There was significant difference ($P<0.05$) found between the batter stability values of mutton shikampuri kebabs with incorporation of whole egg (T6) and control kebabs. Mutton shikampuri kebabs with whole egg (T6) had significantly ($P<0.05$) higher batter stability values than control throughout the storage period during refrigeration at 4±1°C. The significantly ($P<0.05$) higher batter stability values in mutton shikampuri kebabs with whole egg (T6) could be attributed to the better emulsification and binding of moisture and fat by the lecithin provided by the liquid whole egg.

During refrigerated (4±1°C) storage, the mean batter stability values of mutton shikampuri kebabs with whole egg (T6) and control increased non significantly ($P<0.05$) with the advancement of storage period.

There was no literature data in aspect of addition of liquid egg as binder on batter stability in storage period at refrigeration (4±1°C) temperature.

5.6.1.3 Thiobarbituric acid reactive substances (2-TBARS) Value.

2 - Thiobarbituric acid reactive substance value (TBARS) was indicative of degree of lipid oxidation and produced through second stage auto- oxidation in which peroxides are oxidized to aldehydes and ketones which change the colour, aroma, flavour, texture and also the nutritive value of food (Fernandez *et al.* 1997).

There was a significant difference (P<0.05) found between the 2-TBARS values of chicken shikampuri kebabs with whole egg (T3) and control kebabs. During refrigeration (4±1°C) storage, the overall 2-TBARS values increased in both chicken shikampuri kebabs with whole egg (T3) and control during entire storage period. The mean 2-TBARS values of chicken shikampuri kebabs with whole egg (T3) were slightly higher than control kebabs during refrigeration (4±1°C) storage. The values of the chicken shikampuri kebabs with whole egg (T3) were well within limits towards end of storage period. They ranged from 0.26 to 0.91 mg and 0.32 to 0.94 malonaldehyde / kg sample for control and treatment respectively. 2-TBARS value of 2 mg MDA /kg was regarded as the limit beyond which the product was not accepted due to development of rancid odour and taste (Witte *et al*. 1970).

There was a significant difference (P<0.05) found between the 2-TBARS values of mutton shikampuri kebabs (T6) and control kebabs. During refrigeration (4±1°C) storage, the overall 2-TBARS values increased in both mutton shikampuri kebabs with whole egg (T6) and control during entire storage period. The mean 2-TBARS values of mutton shikampuri kebabs with whole egg (T6) were slightly higher than control kebabs during refrigeration (4±1°C) storage. The values of the mutton shikampuri kebabs with whole egg (T6) were well within limits towards end of storage period. They ranged from 0.41 to 1.02mg and 0.47 to 1.10 malonaldehyde / kg sample for control and treatment respectively. 2-TBARS value of 2 mg MDA /kg was regarded as the limit beyond which the product was not accepted due to development of rancid odour and taste (Witte *et al*. 1970).

The slight increase in 2-TBARS in both mutton and chicken shikampuri kebabs with whole egg than their controls might be due to slight increase in fat content in treatments (T3, T6) with whole egg than the controls (C1, C2). The findings are similar with Martina (2017) reported a slight increase in 2-TBARS in chicken cutlets incorporated with different levels of whole egg than the control product.

In both chicken and mutton shikampuri kebabs the TBARS number increased significantly ($P<0.05$) with the advancement of storage period this could be due to the fact that as storage progresses lipid oxidation increased with the production of more secondary products of lipid oxidation formed from the decomposition of oxidized lipid molecules (Melton,1983). The increase in TBARS values on storage might be attributed to oxygen permeability of packing material (Brewer and Wu 1993) that led to lipid oxidation. Similar results were reported by Reddy *et al*. (2013) in aerobically packed restructure mutton slices during refrigerated (4±1°C) storage. Rajan *et al*. (2014) reported that the TBA values of retort processed chettinad chicken increased significantly ($p<0.01$) during the storage period at ambient temperature.

5.6.1.4 Tyrosine value

Tyrosine value was an indicator of proteolysis as it measures the amino acids tyrosine and tryptophan present in a non-protein extract of meat.

There was a significant difference ($P<0.05$) found between the tyrosine values of chicken shikampuri kebabs with whole egg (T3) and control kebabs. During refrigerated (4±1°C) storage, the overall tyrosine values increased in both chicken shikampuri kebabs with whole egg (T3) and control during entire storage period. The mean tyrosine values of chicken shikampuri kebabs with whole egg (T3) were higher than control kebabs during refrigeration (4±1°C) storage.

There was a significant difference (P<0.05) found between the tyrosine values of mutton shikampuri kebabs with whole egg (T6) and control kebabs. During refrigerated (4±1°C) storage, irrespective of formulations, the overall tyrosine values increased in both mutton shikampuri kebabs with whole egg (T6) and control during entire storage period. The mean tyrosine values of mutton shikampuri kebabs with whole egg (T6) were slightly higher than control kebabs during refrigeration (4±1°C) storage.

The more tyrosine value of both mutton and chicken shikampuri kebabs with whole egg might be due to the protein content of egg along with the meat proteins. (Lu and Chen, 1999).

In both chicken and mutton shikampuri kebabs the tyrosine value increased significantly (P<0.05) with the advancement of storage period. It might be due to intrinsic (autolysis) changes in meat and partly due to bacterial action (Agnihotri, 1988). Vedamurthy (1998) reported similar increase in tyrosine value in low fat sausages containing hydrolysed collagen during storage. Gawdaman *et al.* (2017) reported that the tyrosine value was almost in linear increasing in trend with the increase in the levels of minced broiler skin paste incorporation till 15th day of storage.

5.6.2 Microbiological evaluation

5.6.2.1 Total plate count

There was significant difference (P<0.05) found between the total plate counts of chicken shikampuri kebabs with whole egg (T3) and control kebabs. The mean total plate count values of chicken shikampuri kebabs with whole egg (T3) were significantly (P<0.05) lower than those of control kebabs. The total plate counts were increased significantly (P<0.05) with the advancement of storage period under refrigeration storage conditions in control and chicken shikampuri kebabs with whole egg (T3).

There was significant difference (P<0.05) found between the total plate counts of mutton shikampuri kebabs with whole egg (T6) and control kebabs. The mean total plate count values of mutton shikampuri kebabs with whole egg(T6) were significantly (P<0.05) lower than those of control kebabs. The total plate counts were increased significantly (P<0.05) with the advancement of storage period under refrigeration storage conditions in control and mutton shikampuri kebabs with whole egg (T6).

The total plate count values were lower in both mutton and chicken shikampuri kebabs with whole egg (T3, T6) might be due to the presence of egg albumen proteins and lysozyme which are having antimicrobial property Kalaikannnan *et al*. (2007). Even though the kebabs were cooked to an internal temperature of 73°C, lysozyme still has its antimicrobial activity as it denatures at about 80°C (pH 7.2). Moreover, upon heating the lysozyme have shown a consistent increase in antimicrobial activity against gram – negative bacteria with no detrimental effect on the inherent action against gram – positive bacteria (Ibrahim *et al.*1996). Egg yolk has also the potential to reduce the decimal reduction time of *salmonella* and *listeria monocytogenes* (Schuman and Sheldon, 1997). Hence in the present study, egg albumen lysozyme and egg yolk might have increased the destruction of microorganisms, which was indicated by the low initial count. Nath *et al*. (1995), Lee *et al*. (1997), Rao and Reddy (2000), Chidanandaiah *et al.* (2009), Kumar and Tanwar (2011) and Bhat *et al*. (2012) observed a similar increase in total plate count while studying different meat products stored at refrigeration (4±1°C) temperature.

Because of the well-known preservative effect of egg albumen lysozyme (Akashi.1971), in the present study its incorporation in both and mutton and chicken shikampuri kebabs with whole egg significantly ($p<0.05$) decreased the microbial count.

5.6.2.2 Yeast and mould count

There was significant difference ($P<0.05$) found between the yeast and mould counts of chicken shikampuri kebabs (T3) and control kebabs. The mean yeast and mould count values of chicken shikampuri kebabs with whole egg (T3) were significantly ($P<0.05$) lower than those of control kebabs. The yeast and mould counts were increased significantly ($P<0.05$) with the advancement of storage period under refrigeration storage conditions in both control and chicken shikampuri kebabs with whole egg (T3).

There was significant difference ($P<0.05$) found between the yeast and mould counts of mutton shikampuri kebabs with whole egg (T6) and control kebabs. The mean yeast and mould count values of mutton shikampuri kebabs with whole egg (T6) were significantly ($P<0.05$) lower than those of control kebabs. The yeast and mould counts were increased significantly ($P<0.05$) with the advancement of storage period under refrigeration storage conditions in both control and mutton shikampuri kebabs with whole egg (T6).

Yeast and mould counts could not be detect on 0^{th} day at refrigeration (4±1℃) storage in all the shikampuri kebabs irrespective of formulations.

Similar results were observed by Devalakshmi *et al.* (2010) in chicken chips. This increase in the counts during storage might be due to concomitant increase in moisture content that could result in increase of bacterial load during storage. Ibrahim *et al.* (2010) in lamb meat patties with addition of Jojoba, Jatropha, ginseng and ginger

(Natural plant extracts), Zargar *et al.* (2014) in chicken sausages with inclusion of pumpkin and Similar findings with Khan *et al.* (2018) in ready to eat buffalo meat curry.

5.6.3 Sensory Evaluation

5.6.3.1Appearance

The desirability of food for consumer purchase was largely dependent on its appearance, as the colour was the most direct parameter that reflects the meat freshness. The appearance of the final product depends upon the pigment changes that take place during cooking and it gives the first impression of food quality.

The mean appearance scores of chicken shikampuri kebabs with whole egg (T3) were significantly ($P<0.05$) higher than those of control kebabs. The appearance scores were significantly ($P<0.05$) decreased with the advancement of storage period.

The mean appearance scores of mutton shikampuri kebabs with whole egg (T6) were significantly ($P<0.05$) higher than those of control kebabs. The appearance scores were significantly ($P<0.05$) decreased with the advancement of storage period.

The changes in colour quality might be due to lipid oxidation changes resulting in non-enzymatic browning and increase in TBA values during storage. This was in agreement with Sen and Sharma (1996) and Biswas (2002).

5.6.3.2 Flavour

Flavour is a multi-sensory perception produced through the integration of the senses of taste, smell. Many types of heat induced reactions of cooking leads to the production of meat flavours.

In the present study the mean flavour scores of chicken shikampuri kebabs with whole egg (T3) were significantly ($P<0.05$) higher than those of control kebabs. The flavour scores were significantly ($P<0.05$) decreased with the advancement of storage period.

The mean flavour scores of mutton shikampuri kebabs with whole egg (T6) were significantly ($P<0.05$) higher than those of control kebabs. The flavour scores were significantly ($P<0.05$) decreased with the advancement of storage period.

The improvement in flavour scores of treatments may be attributed to antioxidative and antimicrobial activity of egg proteins, which retards the development of off-flavour similar trend in refrigerated storage of the albumen added chicken and duck patties has also been observed (Reddy and Rao, 1997).

The flavour scores decreased with the advancement of storage period in both chicken and mutton shikampuri kebabs. This might be due to the development of oxidative rancidity and microbial deterioration in the product as the efficiency of test ingredients was reduced during storage period (Bali *et al.* 2011).

5.6.3.3 Meat intensity flavour

It's a combination of taste and aroma factors and is also influenced by sensations such as mouth feel and juiciness.

In the present study the mean meat intensity flavour scores of chicken shikampuri kebabs with whole egg (T3) were non significantly ($P>0.05$) lower than those of control kebabs. The meat intensity flavour scores were significantly ($P>0.05$) decreased with the advancement of storage period.

The mean meat intensity flavour scores of mutton shikampuri kebabs with whole egg (T6) were non significantly ($P<0.05$) lower than those of control kebabs. The meat intensity flavour scores were significantly ($P<0.05$) decreased with the advancement of storage period.

The findings are similar to those of Mishra *et al.* (2014) reported that the meat intensity flavour scores of the treatments remains comparable with control in dehydrated chicken rings and also the meat intensity flavour scores decreased with increasing the storage period.

5.6.3.4 Juiciness

Juiciness is defined as the amount of moisture or juice perceived during mastication which is related to the ability of meat proteins to entrap water.

In the present study the mean juiciness scores of chicken shikampuri kebabs with whole egg (T3) were significantly ($P<0.05$) higher than those of control kebabs. The juiciness scores were decreased with the advancement of storage period.

The mean juiciness scores of mutton shikampuri kebabs with whole egg (T6) were significantly ($P<0.05$) higher than those of control kebabs. The juiciness scores were decreased with the advancement of storage period.

Increase in juiciness in treatments might be due to increased moisture level by the addition of whole egg. An increase in moisture levels had been reported to increase juiciness in frankfurters (Chang and Carpenter, 1997).

This might be due to the gradual loss of moisture from the kebabs. The most probable cause might be due to denaturation of proteins and degradation of muscle fiber protein by bacterial action and lowering of water binding capacity. Sachdev and Gopal (2000). The loss of moisture from the product during storage and due to presence of oxygen inside the packaging material might have lead to decreased juiciness scores during storage. Similar results were observed by Bali *et al.* (2011) in chicken sausages with garlic and coriander.

5.6.3.5 Texture

The texture of meat is influenced by the cooking time and temperature. It's the feel or the consistency of product.

In the present study the mean texture scores of chicken shikampuri kebabs with whole egg (T3) were significantly (P<0.05) higher than those of control kebabs. The texture scores were decreased with the advancement of storage period.

The mean texture scores of mutton shikampuri kebabs with whole egg (T6) were significantly (P<0.05) higher than those of control kebabs. The texture scores were decreased with advancement storage period. This might be due to loss of moisture (Wu *et al.* 2000) and depletion of fat (Biswas, 2002) with advancement of storage period.

5.6.3.6 Overall Acceptability

The overall acceptability is a synergistic effect of other sensory parameters like colour, flavour, texture, juiciness and mouth coating ability.

In the present study the mean overall acceptability scores of chicken shikampuri kebabs with whole egg (T3) were significantly (P<0.05) higher than those of control kebabs. The overall acceptability scores were decreased with the advancement of storage period.

The mean overall acceptability scores of mutton shikampuri kebabs with whole egg (T6) were significantly (P<0.05) higher than those of control kebabs. The overall acceptability scores were decreased with the advancement of storage period.

Because of the positive effects of egg proteins on all sensory attributes, this significantly improved the overall palatability scores of shikampuri kebabs with whole egg than control kebabs irrespective of meat.

The present findings are similar to those of Anjaneyulu *et al.* (1990) reported that the overall acceptability scores were higher in buffalo meat patties incorporated with liquid whole egg.

Chapter – VI

SUMMARY

CHAPTER VI

SUMMARY

Meat is a part of the diet for about 60 per cent of people in India. Being a wide country with large number of ethnic groups and diversity in tradition, culture and varied food habits, a large variety of meat products on indigenous taste profile are being prepared and consumed throughout the country. This could be due to their particular sensory properties, high quality and natural composition. These products vary from region to region and place to place. They are mostly native in origin and termed as "traditional or indigenous meat products". People used to consume these meat products in such a way that biochemical and microbial actions can take place not only to help increase the shelf- life but also to enhance flavour and nutritional quality of the products.

"Shikampuri kebab" is an ancient traditional meat product which is a functional food with good source of protein. The exotic famous shikampuri kebab which means belly full referring to the stuffing in the center of kebab and these kebabs are soft, delicate in texture, moisture and gives a melt in the mouth experience.

The present study was carried out and developed both chicken and mutton shikampuri kebab incorporated with liquid egg as binder. Experiments were conducted to optimize the processing conditions and quality evaluation and level of incorporation of different components of liquid egg (egg albumen, egg yolk, whole egg) for the preparation of both chicken and mutton shikampuri kebabs. Salient findings of the study are summarized as follows:

Chicken shikampuri kebab and mutton shikampuri kebab incorporated with three different levels (5%, 7.5%, 10%) of different liquid egg components (egg albumen, egg yolk, whole egg) were used as binder. The preparations were subjected to sensory evaluation and found that the preparations with 10% level of incorporation had significantly ($p<0.05$) higher sensory scores in terms of appearance, flavour, texture, juiciness and overall acceptability than the other levels of addition.

Based on the sensory score, it was concluded that addition of 10% level of different components of liquid egg were having superior sensory scores during preparation of both chicken and mutton shikampuri kebab than remaining formulations and thus it was selected for further study.

The preparation of shikampuri kebab with both chicken and mutton with different liquid egg components (egg albumen, egg yolk, whole egg) as binder were used as treatments i.e., chicken without egg as C1, chicken with egg albumen as T1, chicken with egg yolk as T2, chicken with whole egg as T3 and mutton without egg as C2, mutton with egg albumen as T4, mutton with egg yolk as T5 and mutton with whole egg as T6. The preparations were subjected to sensory, proximate, quality analysis and the results revealed that the addition of whole egg (T3) in chicken shikampuri kebab and whole egg (T6) in mutton shikampuri kebab had significantly ($P<0.05$) higher sensory scores like appearance, flavour, texture, juiciness and overall acceptability, cooking yield than the other components of addition and control.

Based on the above results, chicken shikampuri kebab prepared with whole egg (T3) and mutton shikampuri kebab with whole egg (T6) had significantly ($P<0.05$), higher cooking yield and better sensory scores than control and remaining formulations, thus those were selected for further storage studies.

Hence chicken shikampuri kebab incorporated with whole egg (T3) and control 1 and mutton shikampuri kebab incorporated with whole egg (T6) and Control 2 were aerobically packed in LDPE pouches and stored under refrigeration (4 ± 1°C) temperature for a period of 12 days and evaluated for storage stability.

Physico-chemical characteristics like pH, 2-TBARS value, batter stability and tyrosine value were significantly ($P<0.05$) affected in refrigeration (4 ± 1°C) temperature for both control 1 and chicken shikampuri kebab (T3) with whole egg. There was a significant ($P<0.05$) increase in 2-Thiobarbituric acid reactive substance value, tyrosine value, with progressive storage period at temperatures. How-ever pH was non-significantly ($P>0.05$) increased up to 6^{th} day and significantly ($P<0.05$) increased as the refrigeration storage period progressed. Whereas Batter stability was non significantly ($P>0.05$) increased throughout the storage period.

Physico-chemical characteristics like pH, 2-TBARS value, batter stability and tyrosine value were significantly ($P<0.05$) affected in refrigeration (4 ± 1°C) temperature for both control 2 and mutton shikampuri kebab (T6) with whole egg. There was a significant ($P<0.05$) increase in 2-Thiobarbituric acid reactive substance value, tyrosine value, with progressive storage period. How-ever pH was non-significantly ($P<0.05$) increased up to 6^{th} day and significantly ($P<0.05$) increased as the refrigeration storage period progressed. Whereas Batter stability was non significantly ($P<0.05$) increased throughout the storage period.

Microbiological evaluation revealed that chicken shikampuri kebab (T3) with whole egg had significantly ($P<0.05$) lower total plate count and yeast and mould count during refrigerated storage when compared to control. Also, a significant ($P<0.05$) increase in microbial growth (log10 CFU/g) was noticed during refrigerated storage conditions irrespective of treatments as storage period increases.

Microbiological evaluation revealed that mutton shikampuri kebab (T6) with whole egg had significantly ($P<0.05$) lower total plate count and yeast and mould count during refrigerated storage when compared to control. Also, a significant ($P<0.05$) increase in microbial growth (log10 CFU/g) was noticed during refrigerated storage conditions irrespective of treatments as storage period increases.

Sensory evaluation indicated that chicken shikampuri kebab (T3) with whole egg had significantly ($P<0.05$) higher sensory scores for various eating quality attributes like appearance, flavour, meat intensity flavour, juiciness, texture and overall acceptability scores than the control. However, there was a significant ($P<0.05$) decrease in all the sensory scores of both chicken shikampuri kebab (T3) with whole egg and control as the storage period increased.

Sensory evaluation indicated that mutton shikampuri kebab (T6) with whole egg had significantly ($P<0.05$) higher sensory scores for various eating quality attributes like appearance, flavour, meat intensity flavour, juiciness, texture and overall acceptability scores than the control. However, there was a significant ($P<0.05$) decrease in all the sensory scores of both mutton shikampuri kebab (T3) with whole egg and control as the storage period increased.

Considering all the above results obtained in the present study, it was concluded that both chicken (T3) and mutton shikampuri kebabs (T6) with whole egg supplementing essential nutrients and vitamins could be prepared. In-addition the whole egg improved the batter stability, it could also protect the product from microbial growth due to its natural antimicrobial constituents present in egg besides imparting acceptable pleasing flavour to the product.

LITERATURE CITED

LITERATURE CITED

Abe S Hirata A Kimura T & Yamauchi K 1996 Effects of collagen on the toughness of meat from spent laying hens. Nippon Shokuhin Kogyo Gakkai-Shi *43*(7) 831-834.

Adzitey F Birteeb P and Holdbrook K B 2016 Quality characteristics of whole guinea fowl egg as binder in beef and chevon burgers. Journal of World's Poultry Research 6(2) 66-72.

Adzitey F Teye G A and Boateng F E 2014 Whole Egg of Chicken as a Binder in Beef Burger. Ghana Journal of Science Technology and Development 1(1) 18-26.

Agnihotri M K 1988 A comparitive study on shelf life and microbiological spoilage of refrigerated buffalo meat. Ph D Thesis submitted to IVRI Izatnagar.

Ahmed S N Chattopadhyay U K Sherikar A T and Munde K D 2003 Sensory and physico-chemical evaluation of dressed broiler at refrigerated temperature. Indian Veterinary Journal 80(7) 676-679.

Akashi A 1971 Preservative effect of egg white lysozyme on Vienna sausages. Japanese Journal of Zootechnical Science. 42 289–295.

Alamin S A Elshafia S A and Zein Elabdeen H M 2019 Comparative study on Chemical Composition and Keeping Quality of Camel Meat and Beef sold in Khartoum State, Sudan Journal of Science and Technology (2016) 17(1) 11-18.

Alina A R Mawaddah A N Mashitoh A S Shazamawati Z H Nurulhuda M S Syuhada H U and Imtinan A K 2012 Effect of grilling and roasting on the fatty acids profile of chicken and mutton. World Applied Sciences Journal 17 29-33.

Anandh M A Jagatheesan P R Rajarajan G Kumar P S Paramasivam A and Lakshmanan V 2012 Quality and acceptability of traditional styled fried Tripe products from buffalo and goat rumen meat. International Food Research Journal 19(3) 807-810.

Andres-Bello A Barreto-Palacios V I V I A N Garcia-Segovia P Mir-Bel J and Martinez-Monzo J 2013 Effect of pH on color and texture of food products. Food Engineering Reviews 5(3) 158-170.

Anjaneyulu A R Kondaiah N Salahuddin M and Panda B 1990 Quality of patties from chicken, mutton and combination of meat. J. Food Science and Technology 27 (3) 184-185.

Anjaneyulu A S R Thomas R Gadekar Y P Lakshmanan V and Mahapatra C M 2008 Indian traditional meat products and their processing, quality, present scenario and future prospects. Indian Food Industry 27(2) 53-59.

AOAC 2019 Official Methods of Analysis (21^{st} Ed) Association of Official Analytical Chemists Washington DC USA.

Ayanwale B A Ocheme O B and Oloyede O O 2007 The Effect of Sun-Drying and Oven-Drying on the Nutritive Value of Meat Pieces in Hot Humid Environment. Pakistan Journal of Nutrition 6(4) 370-374.

Azad S A K Naga M E Reddy B G and Kumar N G 2016 Ethnic methodology of preparation of low-fat meat products in North Coastal Andhra Pradesh. Indian Joukrnal of Traditional Knowledge 15(2) 285-291.

Babji Y Murthy T R K and Anjaneyulu A S R 2000 Microbial and sensory quality changes in refrigerated minced goat meat stored under vacuum and in air. Small Ruminant Research 36(1) 75-84.

Babu A J Sundari A R Triveni G and Indumathi J 2010 Study on meat consumption patterns in rural households of chittoor district of Andhra Pradesh. Tamilnadu Journal of Veterinary and Animal Sciences 6(4) 183-187.

Bailey A J 1984 The chemistry of intra molecular collagen. Thc Royal society of Chemistry Burlington Mouse. Recent Advances in Chemistry of Meat, 22-40.

Baker R C Darfler J M and Bourne M C 1968 The effect of level of skin on the quality of chicken frankfurters. Poultry science 47(6) 1989-1996.

Bali A Sudip K D Anupam K Dipanwita P Biswas S and Bhattacharyya D 2011 A comparative study on the antioxidant and antimicrobial properties of garlic and coriander on chicken sausages. International Journal of Meat Science 1 (2) 108-116.

Barbut S 2015 The science of poultry and meat processing.

Bhat Z F Kumar P and Kumar S 2013b Effect of skin, enrobing and refrigerated storage on the quality characteristics of chicken meat balls. Journal of Food Science and Technology 50(5) 890-899.

Bhat Z F Pathak V and Fayaz H 2013a Effect of refrigerated storage on the quality characteristics of microwave cooked chicken seekh kababs extended with different non-meat proteins. Journal of food science and technology 50(5) 926-933.

Bhat Z Fand Pathak V 2012 Quality evaluation of mutton Harrisa during one week refrigerated storage. Journal of food science and technology 49(5) 620-625.

Bingol E B Yilmaz F Muratoglu K Bostan K 2013 Effects of vacuum packaging on the quality of frozen cooked doner kebab. Turkish Journal of Veterinary and Animal Sciences 37(6) 712-718.

Biswas A K 2002 Studies on Enrobing of Pork Patties M.V.Sc Thesis IVRI Deemed University, Izatnagar.

Biswas O Talwar N A Bhattacharya D, Das S K and Chaudhary S 2017 Effect of Refrigeration on Quality and Stability of Fresh Fish and Poultry Muscles. Indian Journal of Anim Health 56(1) 65-76.

Bonilauri P Leonelli R Ferrarini G Carobbi D Ossiprandi M C Dottori M and Cuccurese A 2018 Kebab: Can the traditional cooking process sanitize a natural contamination by listeria monocytogenes?. Italian Journal of Food Safety 7(2) 121-125.

Brewer M S and Wu S Y 1993 Display, packaging, and meat block location effects on color and lipid oxidation of frozen lean ground beef. Journal of Food Science 58(6) 1219-1236.

Burgarella J C Lanier T C and Hamann D D 1985 Effects of added egg white or whey protein concentrate on thermal transitions in rigidity of croaker surimi. Journal of Food Science 50(6) 1588-1606.

Candogan K and Kolsarici N 2003 The effects of carrageenan and pectin on some quality characteristics of low-fat beef frankfurters. Meat Science 64:196-206.

Carballo J Fernandez P Barreto G Solas M T and Colmenero FJ 1996 Morphology and texture of bologna sausage as related to content of fat, starch and egg white. Journal of Food Science, 61(3), 652-665.

Chandirasekaran V and Rajan S 2016 Retort Processed, Indian Traditional Type Chettinad Chicken Product. International Journal of Science, Environment and Technology 5(4) 2395 – 2405.

Chandirasekaran V and Sueshkumar S 2014 Sheep and Goat meat consumption patterns in Salem City Corporation of Tamilnadu. Journal of Environment and Biosciences 28(2) 193-196.

Chang H C and Carpenter J A 1997 Optimizing quality of frankfurters containing oat bran and added water. Journal of Food Science 62(1) 194-197.

Chidanandaiah Keshri R C Sanyal M K 2009 Effect of sodium alginate coating with preservatives on the quality of meat patties during refrigerated storage. Journal of Muscle Foods 20275–292.

Chidanandiah and Keshri R C 2006 Effect of pectin coating on sensory quality of buffalo meat patties. National symposium (IMSACON-II) on prospects and challenges in Indian Meat Industry. July 27-29 TANUVAS Chennai India pp.2.

Clarke A D Sofos J N and Schmidt G R 1988 Effect of algin/calcium binder levels on various characteristics of structured beef. Journal of Food Science 53 711–715.

Dawson P L Sheldon B W and Ball H R 1990 Effect of washing and adding spray dried egg white to mechanically deboned chicken meat on the quality of cooked gels. Poultry Science 69(2) 307-312.

Demirezen D and Uruc K 2006 Comparative study of trace element in certain fish, meat and meat products. Meat Science 74 255-260.

Devalakshmi N Reddy K P and Mallika E N 2010 Physico-chemical, sensory and microbial quality of chicken meat chips. Veterinary World 3(4) 182-184.

Dushyanthan K Babu R N Vasanthi C and Venkataramanujam V 2008 Processing of buffalo meat nuggets utilizing different binders. Tamilnadu J Vet Anim Sci, 4, 77-83.

Dwivedi S Vasavada M N and Cornforth D 2006 Evaluation of antioxidant effects and sensory attributes of Chinese 5-spice ingredients in cooked ground beef. Journal of Food Science 71(1) 12-17.

Farzana N Habib M Ali M H Hashem M A and Ali M S 2017 Comparison of meat yield and quality characteristics between indigenous chicken and commercial broiler. Bangladesh Veterinarian 34(2) 61-70.

Fernandez J Perez-Alvarez J A and Fernandez-Lopez J A 1997 Thiobarbituric acid test for monitoring lipid oxidation in meat. Food Chemistry 59(3) 345-353.

Gagaoua M and Boudechicha H R 2018 Ethnic meat products of the North African and Mediterranean countries an overview. Journal of Ethnic Foods 5(2) 83-98.

Gawdaman G Kumar S S Sudha M Rao V K 2017 Effect of incorporation of minced broiler skin and whole egg malange on the quality of chicken meat patties. Asian Journal of Dairy and Food Research 36(4) 298-303.

Gordon A Barbut S and Schmidt G 1992 Mechanisms of meat batter stabilization: a review. Critical Reviews in Food Science and Nutrition 32(4) 299-332.

Gray J I Gomaa E A and Buckley D J 1996 Oxidative quality and shelf life of meats. Meat science, 43, 111-123.

Griffin C L Orcutt M W Riley R R Smith G C Savell J W and Shelton M 1992 Evaluation of palatability of lamb, mutton, and chevon by sensory panels of various cultural backgrounds. Small Ruminant Research 8(1-2) 67-74.

Gujral H S Kaur A Singh N and Sodhi N S 2002 Effect of liquid whole egg, fat and textured soy protein on the textural and cooking properties of raw and baked patties from goat meat. Journal of Food Engineering 53(4) 377-385.

Gupta M 1990 Studies on incorporation of whole egg liquid in mutton and mutton + chicken combination meat sausages. M.V.Sc. Thesis Indian Veterinary Research Institute Izatnagar India.

Gupta M Kondaiah N and Anjaneyulu A S R 1993 Incorporation of liquid egg into mutton and mutton+chicken sausages. Fleischwirtschaft 73(1) 66–68.

Haritha K 2019 Quality characteristics and storage stability of Gongura Chicken – a traditional meat preparation of coastal Andhra Pradesh PG thesis NTR CVSC, Sri Venkateswara Veterinary University Tirupathi.

Hazra S Biswas S Bhattacharya D Das S K and Khan A 2012 quality of cooked ground buffalo meat treated with the crude extracts of *Moringa oleifera* (Lam) leaves Journal of Food Science Technology 49(2) 240-245.

Hellendoorn E W 1962 Water-binding capacity of meat as affected by phosphates. 1. Influence of sodium chloride and phosphates on water retention of comminuted meat at various pH values. Food Technology 16(9) 119.

Hidayat B T Wea A and Andriati N 2018 Physicochemical, sensory attributes and protein profile by SDS-PAGE of beef sausage substituted with texturized vegetable protein. Food Research 2(1) 20-31.

Huang T C and Ho C T 2001 Flavors of meat products. Meat Science and Applications pp 71-102.

Hughes E Cofrades S and Troy D J 1997 Effects of fat level, oat fiber and carrageenan on frankfurters formulated with 5, 12 and 30% fat. Meat Science, 45(3): 273–281.

Hussain M S Uzzaman M A Hossain M A Alam M K Islam M S Huque R 2006 Effect of gamma irradiation and vacuum packaging on the shelf life extension of beef kebab during refrigerated storage. Bangladesh Journal of Microbiology 23(2) 156-158.

Ibrahim H M Abou-Arab A A and Salem M F A 2010 Addition of some natural plant extracts and their effects on lamb patties quality. Journal of Food Technology 8 (3) 134-142.

Ibrahim H R Higashiguchi S Juneja L R Kim M and Yamamoto T 1996 A structural phase of heat-denatured lysozyme with novel antimicrobial action. Journal of Agricultural and Food Chemistry 44(6) 1416-1423.

ICSMF 1980 Food commodities Microbiological ecology of foods 1980 (Vol. 1). London Academic Press.

Indumathi J Babu A J and Reddy G V 2020 A study on the quality characteristics of gongura mutton curry-an ethnic meat product of Andhra Pradesh, India. Journal of Meat Science 15(2) 29-35.

Indumathi J Moorthy P R S Reddy K S and Babu A J 2011 Development of low-fat chevon patties using sodium alginate as fat replacer. Tamilnadu Journal of Veterinary and Animal Sciences 7(3) 167-173.

Jay J M 1972 Mechanism and detection of microbial spoilage in meats at low temperatures: A status report. Journal of Milk and Food Technology 35(8) 467-471.

Jay J M 1996 Modern Food Microbiology. 5th edn Chapman and Hall New York Pp 28-86.

Jayanthi D Venkataramanujam V 2006 Effect of different packaging methods on physico chemical qualities of chevon. National symposium on prospects and challenges in Indian meat industry Chennai 27-29th July.

Kala R K Kondaiah N Anjaneyulu A S and Thomas R 2007 Evaluation of quality of chicken emulsions stored refrigerated (4±1 C) for chicken patties. International journal of food science & technology 42(7) 842-851.

Kalaikannan A 1998 Studies on incorporation of dried eggs on the quality of patties from spent hen meat and by-products M.V.Sc thesis IVRI Izatnagar India.

Kalaikannan A Anjaneyulu A S R and Santhi D 2007 Effect of egg proteins on the quality and refrigerated storage life of chicken patties made with broiler-spent hen meat and by-products. International journal of food science & technology *42*(5) 579-586.

Kamboj R and Nanda V 2018 Proximate composition, nutritional profile and health benefits of legumes-a review. Legume Research-An International Journal 41(3) 325-332.

Kanatt S R Rao M S Chawla S P and Sharma A 2013 Effects of chitosan coating on shelf-life of ready-to-cook meat products during chilled storage. LWT-Food Science and Technology 53(1) 321-326.

Kandeepan G and Biswas S 2007 Effect of domestic refrigeration on keeping quality buffalo meat. Journal of Food Technology 5(1) 29-35.

Kandeepan G Anjaneyulu A S R Kondaiah N and Mendiratta S K 2011 Comparison of quality attributes of buffalo meat curry at different storage temperature. Acta Scientiarum Polonorum Technologia Alimentaria 10(1) 87-95.

Kandeepan G Anjaneyulu A S R Kondaiah N Mendiratta S K and Lakshmanan V 2009 Effect of age and gender on the processing characteristics of buffalo meat. Meat Science 83(1) 10-14.

Kandeepan G Biswas S and Porteen K 2006 Influence of histological changes of refrigerator preserved buffalo meat on quality characteristics. Journal of Food Technology 4(2) 116-121.

Khan M A Patel M S K K and Chaudhary P 2018 Shelf-Life Study of Ready-to-Eat Buffalo Meat Curry. Advances in Food Science and Engineering 2(4) 136-145.

Kilic B 2009 Current trends in traditional Turkish meat products and cuisine. LWT-Food Science and Technology 42(10) 1581-1589.

Kiran M Prabhu K N Paramesha S C Rajshekar T Praveen M P Punitkumar C and Nagabhushan C 2018 Consumption pattern, consumer attitude and consumer perception on meat quality and safety in Southern India. International Food Research Journal 25(3).

Kondaiah N and Panda B 1989 Effect of phosphate and spent hen yolk on the quality of chicken sausages from spent hens. Poultry Science 68(3) 393-398.

Kondaiah N Anjaneyulu A S R Rao V K Sharma N and Joshi H B 1985 Effect of salt and phosphate on the quality of buffalo and goat meats. Meat Science 15(3) 183-192.

Kraig B and Sen C T 2013 Street food around the world: an encyclopedia of food and culture: an encyclopedia of food and culture.

Kumar A Gupta S Hakeem H R and Shafat S 2010 Comparative effect of incorporation of egg albumin liquid and skim milk powder in chevon patties. Journal of Veterinary Public Health 8(1) 45-49.

Kumar D and Tanwar V K 2011 Effects of incorporation of ground mustard on quality attributes of chicken nuggets. Journal of food science and technology 48(6) 759-762.

Kumar M and Sharma B D 2004 The storage stability and textural, physico-chemical and sensory quality of low-fat ground pork patties with Carrageenan as fat replacer. *International Journal of Food Science & Technology 39*(1) 31-42.

Kumar R R and Sharma B D 2005 Evaluation of the efficacy of sorghum flour as extender in chicken patties. Journal of Meat Science 3(1) 17-20.

Kumar R R Sharma B D Kumar M Chtdanandaiah and Biswas A K 2007 Storage quality and shelf life of vacuum packaged extended chicken patties. Journal of Muscle Food 18(3) 253-263.

Kyriakopoulou K Keppler J K and van der Goot A J 2021 Functionality of ingredients and additives in plant-based meat analogues. *Foods 10*(3) 600.

Laranjo M, Talon R, Laukova A, Fraqueza M J and Elias M 2017 Traditional meat products:improvement of quality and safety. Journal of Food Quality.

Lawrie R A 1991 Meat science. 5th Edition Pergamon Press New York USA.

Lee J H Kouakou B and Kannan G 2008 Chemical composition and quality characteristics of chevon from goats fed three different post-weaning diets. Small Ruminant Research 75(2-3) 177-184.

Lee T G Williams S K Sloan D and Littell R 1997 Development and evaluation of a chicken breakfast sausage manufactured with mechanically deboned chicken meat. Poultry Science 76(2) 415-421.

Lijalem T Beyan M and Banerjee S 2015 Quality of beef, chevon and mutton at Hawassa, Southern Ethiopia. African Journal of Food Science, 9(5), 301-306.

Lin KW and Keeton J T 1998 Textural and physicochemical properties of low fat, precooked ground beef patties containing carrageenan and sodium alginate. Journal of Food Science, 63(4):571-574.

Lu C L and Baker R C 1986 Characteristics of egg yolk phosvitin as an antioxidant for inhibiting metal catalysed phospholipid oxidation. Poultry Science. 65 2065–2070.

Lu G H and Chen T C 1999 Application of egg white and plasma powders as muscle food binding agents. Journal of Food Engineering 42(3) 147-151.

Mandal P K Pal U K Das C D and Rao V K 2002 Changes in the quality of restructured cured chicken during refrigerated storage. Indian Journal of Poultry Science 37(2) 151-154.

Martina G 2017 Evaluation of Chicken Cutlets Incorporated with Whole Egg Liquid. International Journal of Agriculture Sciences ISSN 0975-3710.

McAfee A J McSorley E M Cuskelly G J Moss B W Wallace J M Bonham M P and Fearon A M 2010 Red meat consumption: An overview of the risks and benefits. Meat science 84(1) 1-13.

Mc Watters K H 1990 Functional characteristics of cowpea flours in feeds. Journal of American Oil Chemists Society 67 272–276.

Mehta N Ahlawat S S Sharma D P and Dabur R S 2015 Novel trends in development of dietary fiber rich meat products a critical review. Journal of Food Science and Technology 52(2) 633– 647.

Melton S L 1983 Methodology for following lipid oxidation in muscle foods. Food Technology (USA) 37:105-111.

Mendiratta S K Kondaiah N Anjaneyulu A S R and Sharma B D 2008 Comparisons of handling practices of culled sheep meat for production of mutton curry. Asian-Australasian Journal of Animal Sciences 21(5) 738-744.

Michalczuk M Jozwik A Damaziak K ZdanowskaSasiadek Z Marzec A Gozdowski D and Strzalkowska N 2016 Age-related changes in the growth performance, meat quality, and oxidative processes in breast muscles of three chicken genotypes. Turkish Journal of Veterinary and Animal Sciences 40(4) 389-398.

Mishra B P Chauhan G Mendiratta S K and Rath P K 2014 Storage stability of vacuum packaged extended dehydrated chicken meat rings at ambient temperature. Indian Journal of Animal Sciences 84(11) 1222-1227.

Mishra B P Chauhan G Mendiratta S K Sharma B D Desai B A and Rath P K 2015 Development and quality evaluation of dehydrated chicken meat rings using spent hen meat and different extenders. Journal of food science and technology 52(4) 2121-2129.

Modi V K Sachindra N M Nagegowda P Mahendrakar N S and Narasimha Rao D 2007 Quality changes during the storage of dehydrated chicken kebab mix. International Journal of Food Science and Technology 42(7) 827-835.

Modi V K Sachindra N M Sathisha A D Mahendrakar N S and Narasimha Rao D 2006 Changes in quality of chicken curry during frozen storage. Journal of muscle foods 17(2) 141-154.

Modi V K Yashoda K P Bhaskar N and Mahendrakar N S 2009 Effect of carrageenan and oat flour on storage characteristics of fried mutton kofta. Journal of Food Processing and Preservation 33(6) 763–776.

Mohammed H H H Jin G Ma M Khalifa I Shukat R Elkhedir A E and Noman A E 2020 Comparative characterization of proximate nutritional compositions, microbial quality and safety of camel meat in relation to mutton, beef, and chicken. LWT 118 108714.

Mood F G Mohsenzadeh M Housaindokht M R and Varidi M 2016 Microbial and chemical spoilage of chicken meat during storage at isothermal and fluctuation temperature under aerobic conditions. Iranian journal of veterinary science and technology 8(1) 38-46.

Mudryu A N Yu N and Aukema H M 2014 Nutritional and health benefits of pulses. Applied Physiology, Nutrition, and Metabolism 39(11) 1197-1204.

Murphy E W Criner P E and Gray B C 1975 Comparisons of methods for calculating retentions of nutrients in cooked foods. Journal of Agricultural and Food Chemistry 23(6) 1153-1157.

Mursheda H M Sarkerb M A H Rahmana S M E Hashema M A 2014 Comparison of carcass and meat quality of Black Bengal goat and Indigenous sheep of Bangladesh. Journal of Meat Science and Technology 2(3) 63-67.

Murthy T R K and Bachhil V N 1980 Influence of pH on hydration during spoilage of pork at refrigeration temperature. Journal of Food Science and Technology 17(4) 201–202.

Mushi D E Eik L O Thomassen M S Sorheim O and Adnoy T 2008 Suitability of Norwegian short-tail lambs, Norwegian dairy goats and Cashmere goats for meat production–Carcass, meat, chemical and sensory characteristics. Meat Science, 80(3), 842-850.

Nag S Sharma B D Kumar S 1998 Quality attributes and shelf life of chicken nuggets extended with rice flour. Indian Journal of Poultry Science 33 (2)182–186.

Nagamallika E Reddy K P and Reddy P M 2006 Effect of storage on physico-chemical microbiological and sensory quality of chicken patties. Indian Journal of Poultry Science, 41(3), 271-274.

Nath R L Mahapatra C M Kondaiah N Anand S K Singh J N 1995 Effect of levels of chicken fat on the quality and storage life of chicken patties. Indian Journal of Poultry Science 30(1) 52–57.

Naveena B M Muthukumar M Sen A R Babaji Y and Murthy T R K 2006 Quality characterestrics and storge stability of chicken patties formulated with finger millet flour (Eleusina coracana). Journal of Muscle Foods 17(1) 92-104.

Nayar R Rajagopal K Rajkumar S and Thomas M 2021 Documentation and Evaluation of Traditional Meat Products of North Malabar. International Journal of Current Microbiolgy and Applied Sciences 10(01) 1184-1194.

Okuskhanova E Yessimbekov Z Suychinov A Rebezov M Semenova N Rebezov Y and Zinina O 2017 Study of water binding capacity, pH, chemical composition and microstructure of livestock meat and poultry. Annual Research & Review in Biology 14(3) 34413-34413.

Orr L and Fletcher J E 1975 Egg and egg products McGraw Hill Book Company Inc New York 1-64pp.

Ossom R N Adzitey F and Teye G.A 2016 The effect of higher levels of egg albumen as binder in beef burger. Journal of Food Research and Technology 4 16-20.

Padda G S Keshri R C Sharma B D and Sharma N 1988 The effects of some extenders/binders on organoleptic and chemicalproperties of pork koftas. Indian Journal of Meat Science and Technology, 1(2): 9-13.

Pandey M C Harilal P T and Radhakrishna K 2014 Effect of processing conditions on physico-chemical and textural properties of shami kebab. International Food Research Journal 21(1) 223.

Pandey N K and Yadav A S 2011 Development quality evaluation and shelf life of egg strips under vaccum and aerobic packaging Fleischwirtschaft International Journal for Meat Production and Meat Processing, 26(2) 72-74.

Panozzo M Magro L Erle I Ferrarini S Murari R Novelli E Masaro S 2015 Nutritional quality of preparations based on Doner Kebab sold in two towns of Veneto Region, Italy: preliminary results. Italian Journal of Food Safety 4(2) 92-97.

Pati P K Anjaneyulu A S R and Kondaiah N 1992 Effect of buffalo fat premix on the quality of patties. Journal of Food Science Technology 29(3) 167–169.

Pearson D 1968 Application of chemical methods for the assessment of beef quality. II. Methods related to protein breakdown. Journal of the Science of Food and Agriculture 19(7) 366-369.

Petrovic L Dzinic N Ikonic P Tasic T and Tomovic V 2011 Quality and safety standardization of traditional fermented sausages. Scientific Journal Meat Technology 52(2) 234-244.

Pietrasik Z 2003 Binding and textural properties of beef gels processed with kappa carrageenan, egg albumin and microbial transglutaminase. Meat Science, 63(3)317–324.

Prabhakara Reddy K and Satyanarayana Reddy P V V 1990 A study on duck meat physic chemical and chemical characteristics. Indian Veteterinary Journal 67(7) 637–642.

Rai A K Palni U and Tamang J P 2009 Traditional knowledge of the ethnic Himalayan people on production of indigenous meat products. Indian Journal of Traditional Knowledge 8(4) 586-591.

Rai A K Tamang J P and Palni U 2010 Microbiological studies of ethnic meat products of the Eastern Himalayas. Meat science 85(3): 560-567.

Rajaei M Moosavy M H Gharajalar S N and Khatibi S A 2021 Antibiotic resistance in the pathogenic foodborne bacteria isolated from raw kebab and hamburger: phenotypic and genotypic study. BMC microbiology 21(1) 1-16.

Rajan S Kulkarni V V Chandirasekaran V 2014 Preparation and storage stability of retort processed Chettinad chicken. Journal of food science and technology 51(1) 173-177.

Ram C P and Sharma S 2018 Impact of Different Food Cultures on Cuisine of Delhi. International Journal of Research and Review 2454-2237.

Ramakrishnan C Babu R N Rao V A Abraham R J and Ruban S W 2017 Effect Of Different Storage Conditions On Quality Characteristics Of Chicken Carcasses. Journal of Environment and Bio-Sciences 31(1) 89-91.

Rao B J Reddy K P 2000 Influence of binders and refrigerated storage on the quality of chicken meat loaves. Indian Journal of Poultry Science 35(3) 302–305.

Rao B E Bhaskar K Mallika E N Naveen Z and Gupta R S D 2017 A study on consumption pattern of meat in and around rural locality of Gannavaram (Andhra Pradesh). Chemical Science Review and Letters 6(23), 1363-1368.

Reddy G B Sen A R Nair P N Reddy K S Reddy K K Kondaiah N 2013 Effects of grape seed extract on the oxidative and microbial stability of restructured mutton slices. Meat Science 95(2) 288-294.

Reddy G V B 2011 Studies on development, quality evaluation and storage stability of restructured mutton product. Ph.D thesis, CVSc, Sri venkateswara veterinary university Rajendranagar, Hyderabad.

Reddy P K Rao S T 1997 Influence of binders and refrigerated storage on certain quality characteristics of chicken and duck meat patties. Journal of Food Science Technology 34(5) 446–449.

Romanoff A L and Romanoff A J 1949 The avian egg. The avian egg.

Sachdev A K and Gopal R 2000 Storage quality changes in cooked chicken rolls. Indian Journal of Poultry Science 35(3) 364-366.

Salahuddin M Malik A H and Pal M A 2013 specialty meat products of Jammu and Kashmir- Production and scope of R & D. Compendium IMSACON –V Feb 7-9 145-152.

Santos C Gomes A and Roseiro L C 2011 Polycyclic aromatic hydrocarbons incidence in Portuguese traditional smoked meat products. Food and Chemical Toxicology 49(9) 2343-2347.

Santos V A C Silva S R Azevedo J M T D 2008 Carcass composition and meat quality of equally mature kids and lambs. Journal of Animal Science 86(8) 1943-1950.

Sasse A Colindres P and Brewer M S 2009 Effect of natural and synthetic antioxidants on the oxidative stability of cooked, frozen pork patties. Journal of Food Science 74(1) S30-S35.

Schonfeldt H C Naude R T Bok W Van Heerden S M.Sowden L and Boshoff E 1993 Cooking and juiciness related quality characteristics of goat and sheep meat. Meat Science 34(3) 381-394.

Schuman J D and Sheldon B W 1997 Thermal resistance of Salmonella sp. and Listeria monocytogenes in liquid egg yolk and egg white. Journal of Food Protection 60(6) 634–638.

Sen A R and Sharma B D 1996 Quality attributes of chicken loaves with potato as extender. Indian journal of animal sciences 66(2) 209-210.

Sen A R Santra A and Karim S A 2004 Carcass yield, composition and meat quality attributes of sheep and goat under semiarid conditions. Meat science 66(4) 757-763.

Serdaroglu M and Ozsumer M S 2003 Effects of soy protein, whey powder and wheat gluten on quality characteristics of cooked beef sausages formulated with 5, 10 and 20% fat. Electronic Journal of Polish Agricultural Universities FoodScience and Technology 6(2) 1-9.

Shija D S Mtenga L A Kimambo A E Laswai G H Mushi D E Mgheni D M and Safari J G 2013 Chemical composition and meat quality attributes of indigenous sheep and goats from traditional production system in Tanzania. Asian-Australasian journal of animal sciences 26(2) 295.

Shukla V Kandeepan G and Vishnuraj M R 2015 Evaluation of shelf life of buffalo meat in aerobic cold storage using physicochemical parameters. Buffalo Bulletin 34(4).

Simsek A Kilic B 2020 Influences of encapsulated polyphosphate incorporation on oxidative stability and quality characteristics of ready to eat beef Doner kebab during storage. Meat Science 169 108217.

Singh P K Kumar S Bhat Z F Kumar P 2015 Effect of sorghum bicolour and clove oil on the quality characteristics and storage quality of aerobically packaged chevon cutlets. Nutrition & Food Science 45(1) 145-163.

Singh R P Yadav A S and Verma S S 2001 Development, flexible packaging and ambient storage quality of intermediate moisture chicken meat. Indian Journal of Poultry Science, 36(1), 82-86.

Srinivas T Rao P P and Sridhar T V 2018 Usage Pattern of ICT Tools by the farm varsity students in India. Journal of Agricultural Science and Research 8 (5) 23-30.

Strange E D and Benedict R C 1978 Effect of postmortem boning times on beef storage quality. Journal of Food Science, 43(6), 1652-1655.

Strange E D Benedict R C Smith J L and Swift C E 1977 Evaluation of rapid tests for monitoring alterations in meat quality during storage I. Intact meat. Journal of Food Protection 40(12) 843-847.

Sudha M Dushyanthan K Sivakumar T and Venkataramanujam V 2008 Comparative Effect of Whole Egg Liquid and Skim Milk powder as Binder for Pork Patties. Tamilnadu Journal of Veterinary and Animal Sciences 4(2) 41-47.

Sunil Kumar K Chandra gowda C T Kiran M Mutkumar M Naveena B M and Nadeem fairza 2013 Compendium IMSACON-V souvenir 2.16 289-290.

Sunki G R Annapureddy R Rao O D 1978 Microbial, biochemical and organoleptic changes in ground rabbit meat stored at 5 to 7°C. Animal Science 46(3) 584–588.

Suradkar U S Bumla N A Maria A Pal V N and Jasvinder S S 2012 study on sensory and quality attributes of chicken nuggets incorporated with different levels of whole egg liquid. Wayamba Journal of Animal Sciences ISSN 578X 495-478.

Suresh A 2016 Consumers attitude towards meat consumption in India: insights from a survey in two metropolitan cities. Livestock Res. Rural Dev 28(3).

Swift C E and Sulzbacher W L 1963 Comminuted meat emulsions-factors affecting meat proteins as emulsion stabilizers. Food Technology 17(2) 224.

Talukder S Mendiratta S K Soni A Singh T P Chhangte L Kumar R R and Irshad A 2015 Development and quality characterization of mutton snack. Nutrition and Food Science 45(6) 873-882.

Tarladgis B G Watts B M Younathan M T and Dugan Jr L 1960 A distillation method for the quantitative determination of malonaldehyde in rancid foods. Journal of the American Oil Chemists Society 37(1) 44-48.

Thamizhannal M Appa Rao V Satheesh Raja S Arul S and Thanigaivel P 2017 Physico-chemical properties of chicken meat stored in eco-friendly packaging materials. International Journal of Agricultural Environment and Bioresearch 2(1) 53-59.

Thomas R Anjaneyulu A S R and Kondaiah N 2006 Quality and shelf-life evaluation of emulsion and restructured buffalo meat nuggets at cold storage (4±1ºC). Meat Science. 72(3) 373-379.

Tolstoguzov V B 1991 functional properties of food proteins and role of protein polysaccharide interaction. Food Hydrocolloids, 4(6) 429-468.

Tong H B Cai J Lu J Wang Q Shao D and Zou J M 2015 Effects of outdoor access days on growth performance, carcass yield, meat quality, and lymphoid organ index of a local chicken breed. Poultry Science 94(6) 1115-1121.

Tong H B Wang Q Lu J Zou J M Chang L L and Fu S Y 2014 Effect of free-range days on a local chicken breed. Growth performance, carcass yield, meat quality, and lymphoid organ index. Poultry Science 93(8) 1883-1889.

Tornberg E 2005 Effects of heat on meat proteins–Implications on structure and quality of meat products. Meat Science 70(3) 493-508.

Troutt E S Hunt M C Johnson D E Claus J R Kastner C L Kropf D H and Stroda S 1992 Chemical, physical, and sensory characterization of ground beef containing 5 to 30 percent fat. Journal of Food Science 57(1) 25-29.

Tshabalala P A Strydom P E Webb E C and De Kock H L 2003 Meat quality of designated South African indigenous goat and sheep breeds. Meat Science 65(1) 563-570.

Vazgccer B Ulu H and Oztan A 2004 Microbiological and chemical qualities of chicken doner kebab retailed on the Turkish restaurants. Food Control 15(4) 261-264.

Vedamurthy C B 1998 Utilization of collagen isolated from skin for production of low fat sausages, M.V.Sc. Thesis, IVRI Deemed University and Izatnagar.

Verma A K Rajkumar V Banerjee R Biswas S and Das AK 2013 Guava (*Psidium guajava* L.) powder as an antioxidant dietary fibre in sheep meat nuggets. Asian Australian Journal of Animal Science 26(6) 886–895.

Verma S K Zanjad P N Biswas S Kumar P and Kumari B 2012 Effect of addition of sodium caseinate, whole egg powder on the quality of chicken sausage made with poultry by-products. Journal of Animal Research 2(3) 271-284.

Vivekanandareddy B V 2019 Development and quality evaluation of restructured buffalo meat slices with moringa leaf powder. PG thesis CVSC Sri Venkateswara Veterinary University Tirupathi.

Wang B Wang Z Chen Y Liu X Liu K Zhang Y and Luo H 2021 Carcass Traits, Meat Quality, and Volatile Compounds of Lamb Meat from Different Restricted Grazing Time and Indoor Supplementary Feeding Systems. *Foods 10*(11) 2822.

Wang C and Shelef L A 1991 Factors contributing to antilisterial effects of raw egg albumen. Journal of Food Science. 56 1251–1254.

Wier C E 1960 Palatability characteristic of meat. In Science of Meat and Meat Products. AMIF Reinkhold Publishing co New York Pp 212.

Williams P Droulez V Levy G and Stobaus T 2007 Composition of Australian red meat 2002 3. Nutrient profile. Food Australia 59(7) 331-340.

Wills R B H McGlasson W B Graham D and Joyce D 1998 Postharvest. Am. Introduction to the physiology and handling of the fruit, vegetables and ornamentals 4th ed. New South Wales University Press. Sydney Austraila 10-15.

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. Journal of Food Science 35(5) 582-585.

Wu Y Rhim J W Weller C L Hamouz F Cuppett S and Schnepf M 2000 Moisture loss and lipid oxidation for precooked beef patties stored in edible coatings and films Journal of Food Science 65(2) 300-304.

Xiong Y L 1994 myofibrillar protein from different muscle fiber types: implications of biochemical and functional properties in meat processing. Critical Reviews Food Science and Nutrition, 34: 293-320.

Yamamoto Y Sogo N Iowa R and Miyamoto T 1990 Antioxidant effect of egg yolk on linoleate in emulsions. Agricultural Biological Chemistry 54(12) 3099–3104.

Yapar A Atay S Kayacier A Yetim H 2006 Effects of different levels of salt and phosphate on some emulsion attributes of the common carp. Food Hydrocoll 20:825-830.

Zargar F A Kumar S Bhat Z F and Kumar P 2014 Effect of pumpkin on the quality characteristics and storage quality of aerobically packaged chicken sausages. Springer Plus 3(1) 39.

APPENDIX

Dept. of Livestock Products Technology, NTR CVSc., Gannavaram,

SCORE CARD FOR SENSORY EVALUATION

Name: Name of the product:

Designation: Code no. of the product:

Evaluation Date and Time:

SCORE

1. Extremely poor	(highly undesirable)
2. Poor	(undesirable)
3. Moderately Poor	(slightly undesirable)
4. Just Poor	(improvement is necessary)
5. Fair	(improvement is desirable)
6. Just Good	(improvement is desirable)
7. Moderately Good	(minor improvement is desirable)
8. Good	(improvement can be made)
9. Excellent	(can think of no improvement)

Sample No.	Appearance	Flavour	Meat Intensity Flavour	Texture	Juiciness	Overall Acceptability
1						
2						
3						
4						

GENERAL COMMENTS AND SUGGESTIONS PLEASE:

The product should be judged according to the above criteria with appropriate score numbers in the relevant columns. Any additional comments would be greatly appreciated and may be written in the space provided for the purpose.

Signature