PROCESS STANDARDIZATION OF FIBRE RICH CHEVON NUGGETS INCORPORATED WITH GREEN BANANA PULP POWDER

T H E S I S

Submitted

in partial fulfillment of the requirements for the Degree of

MASTER OF VETERINARY SCIENCE

IN

LIVESTOCK PRODUCTS TECHNOLOGY

BY

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(INDIA)

2021

DECLARATION OF STUDENT

I hereby declare that the experimental research work and interpretation of the thesis entitled "**PROCESS STANDARDIZATION OF FIBRE RICH CHEVON NUGGETS INCORPORATED WITH GREEN BANANA PULP POWDER**" or part thereof has not been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis/publication of any University or scientific organization. The sources of materials used and all assistance received during the course of investigation have been duly acknowledged.

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Shri. SHAIKH SULTAN FAZLUR RHEMAN has satisfactorily prosecuted his course of research for a period of not less than one semester and that the thesis entitled. **"PROCESS STANDARDIZATION OF FIBRE RICH CHEVON NUGGETS INCORPORATED WITH GREEN BANANA PULP POWDER''** submitted by him/her is the result of research work is sufficient to warrant its presentation to the examination in the subject of **LIVESTOCK PRODUCTION TECHNOLOGY** for the award of **MASTER OF VETERINARY SCIENCE** degree by the Maharashtra Animal and Fishery Sciences University, Nagpur.

We also certify that the thesis or part thereof has not been previously submitted by him/her for a degree of any other University.

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CERTIFICATE

This is to certify that the thesis entitled **"PROCESS STANDARDIZATION OF FIBRE RICH CHEVON NUGGETS INCORPORATED WITH GREEN BANANA PULP POWDER''** submitted by Shri. **SHAIKH SULTAN FAZLUR RHEMAN** to the Maharashtra Animal and Fishery Sciences University in partial fulfillment of the requirement for the degree of **MASTER OF VETERINARY SCIENCE** has been approved by the Student's Advisory Committee after examination in collaboration with the External Examiner.

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ACKNOWLEDGEMENT

To be or not to be grateful is not a question, how to be is the one. Traditional and formal words are in plenty but their „traditional use‟ has turned this pleasant duty into formality. This formidable will not project the picture of volcano of feelings that is rumbling and struggling to burst out of me through words to express my deep sense of gratitude to many known and unknown hands which pushed me forwards, lips put elixir in my heart, learned soul put me on the right path and enlightened me with their experience, knowledge and wisdom.

Foremost, I would like to express my sincere gratitude and indebtedness to my honourable and enthusiastic guide, chairman of Advisory committee **Dr.A.A. Devangare,** Associate Professor, Dept. of Livestock Products Technology, for continuous support of my M.V.Sc. study and research, his valuable suggestions, kind cooperation, helpful criticism and affection during the entire period of research work.

I am sincerely indebted to **Dr. R. R. Mugale,** Associate Dean, College of Veterinary and Animal Sciences, Udgir; for providing all the necessary facilities during this investigation.

I am highly obligated to **Dr. N. Z. Gaikwad,** Professor and Head of Veterinary Biochemistry, who generously helped me colour the mosaic of dissertation with styles of their knowledge, expertise, guidance and rational criticism. I am grateful to **Dr. S.P. Awandkar**, Assistant professor, Department of Veterinary Microbiology for his valuable help during this investigation. I express my special thanks to **Dr. R.C. Kulkarni** for his sagacious guidance and encouragement.

I owe my special thanks to **Dr.R.D. Suryawanshi** for his unflinching interest relentless efforts and generosity. I am also grateful to **Dr. Kawitkar** sir for providing necessary facility during my research work. My sincere thanks to **Dr. Dongre sir**, Assistant Professor of Animal Genetics and Breeding, for his valuable help in analysing the research data. I will be failing in my duties if I do not recall help offered by **Dr. M. A. Khan, Raziuddin sir, Chappalwar madam** for his guidance and kind cooperation.

I would like to extend my gratitude to **Dr.Asmita Khade, Sachin Indurkar, Bhumika, Pratik & Chetan** for their vital help made my research work easy and enjoyable. I take this opportunity to sincerely thanks to my friends Nepanesir,supriya,Dhananjay,abdul,pandharinath,dhas,Manjusha,Kalpana,Ajay babar,Deshmukh,wishranti,abhishek,Aditya who have contributed immensely to my personal and professional time during my entire study period. I feel sincere thanks to my best friend **Junaid** and **Amit sir** for their support throughout my research work.

Behind my success, there is my family architecture base of ideals, brick of emotions and roof of rituals. I deem it my immense pleasure to put on record my deep sense of gratitude towards my parents **Shaikh Fazlur Rheman** and **Shaikh Rahimunisa begum,** for their love, affection, blessing, goodwill, encouragement, inspiration and sacrifice. I fall short of words to express my deep sense of reverence and indebtedness to my brother in low shaikh sultan & brother shaikh Mujeeb and Shafiqur raheman for unflagging love and patience during my study.

I cannot weigh my feeling with my words and something that is inexpressible in my heart for my sister Parvin, Shaheen & Yasmeen sultana for their ever most love and affection.

This thesis is by far the most significant scientific accomplishment of my life. Several other people have knowingly or unknowingly helped me in the successful completion of this piece of research. I am grateful to everyone, but it is extremely difficult to thank each and every one of them individually. I hope this shortcoming will be pardoned.

Shaikh Sultan Fazlur Rheman

Place: Udgir

Date:

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ABBREVIATIONS

AMR	:	Antimicrobial agents
AOAC	:	Association of analytic chemist
APHA	:	American public health association
@	:	at the rate
B.C	:	Before Christ
b. wt	:	Body weight
CD	:	Critical difference
Cfu	:	Colony forming unit
cm	:	Centimeter
^{0}C	:	Degree Celsius
E. coli	:	*Escherichia coli*
et al.	:	And associates
etc		And the others
ft.	:	Feet
GBPP	:	Green banana pulp powder
gm	:	Gram
HCL	:	Hydrochloric acid
HDPE	:	High density polyethelene
Hr	:	Hours

i.e.	:	that is
IU	:	International Unit
LDPE	:	Low density polyethelene
Mg	:	Milligram
ml	:	Milliliter
Min	:	Minute
Nacl	:	Sodium chloride
OD	:	Optical density
%	:	percent
P^H	:	Power of hydrogen ion
ppm	:	Parts per million
RWF	:	Refined wheat flour
SE	:	Standard error
STPP	:	Sodium tripolyphosphate
TPC	:	Total plate count
USDA	:	United States department of agriculture
viz.	:	Namely

Introduction

CHAPTER-I

INTRODUCTION

Globally the livestock sector is highly dynamic and in developing countries, there is rapid increase in the demand of livestock products (Thornton, 2010). Meat may be a valuable product and a crucial supply of protein. The meat handiness in Asian country is just concerning 15g/person/day against the ICMR recommendation of 30g/person/day (Islam *et al.*, 2016).

Meat has been consumed by humans, typically in prodigious amounts, throughout history and is taken into account by anthropologists mutually of the factors that diode to evolution of larger brains. In recent decades, several empirical studies of individuals have associated consumption of red or processed meats (Boada *et al.*, 2016).It is most generally used necessary food artefact of animal origin food. It contains quality protein, taste property enhancing fat, energy providing carbohydrates, essential amino acids and micronutrients viz, iron, zinc, copper, sodium, potassium, Magnesium and phosphorus and vitamin B complex specially vit B_1, vit B_2, niacin, pyridoxine and cobalamin that create it a diet (Biesalski, 2005).

At present India's meat production is 7.4 million tons per annum to that goat meat contribute concerning 14.25 per cent, Goat meat is one amongst the foremost consumed red meats worldwide and through previous few years respectable increase in consumption of chevon (Madruga and Bressan,2011). The increase in demand was chiefly because of the expansion of ethnic populations and additionally the notice of health-conscious shoppers of lower fat in chevon compared to different red meats. Asian country distributes each frozen and recent chilled meat (Guleria *et al.*, 2015).

Goats doubtless function was essential supply of red meat to humans (Web *et al*. 2005), especially in developing countries. It is calculable that ninety eight percent of the goat population is in developing countries wherever over

thirty healthier or original breeds occur that area unit under-utilized (Devendra 2010).

In India, goat meat (chevon) is right on top of mutton (Sen *et al*., 2004).In developing countries because of fast globalisation, urbanization, industrialisation, the peoples like quick foods which incorporates sort of meat product viz, cured meats patties, nuggets, meat balls (Aminzare *et al.*, 2016).

Largely ground, restructured and emulsions primarily based product are studied either alone or combination to yield product with natural, useful and nutritional properties as meat product lack dietary fibre, wealthy in fat that area unit susceptible to many disorders like carcinoma, obesity, vas diseases (Beecher,1999). Useful product has extra nutritionary ingredients that improve health similarly as contain lesser amount of harmful compounds like sterol, fat etc (Diplock *et al*., 1999 and Yue, 2001).

Functional property and health advantageous effects of fibres create them a helpful ingredient within the development of many meats product. However, increasing fibre consumption within the diet is usually a troublesome challenge. That's why fibre usually employed in food product, mustn't solely offer fibre, however additionally offer improved useful properties to create high-fibre foods like style higher, therefore and provoking continued high fibre intake. fibres from apple, sugar beet, soy, pea, oat and wheat are concerned within the formulations of diverse meat product like sausage, patties and bologna (Backers and Noll, 2001; Mansour and Khalil, 1997).

Ninety-five per cent of goat meat made is consumed domestically and there's a major potential for developing goat production for internal consumption and additionally for export. Asian country ranks high between the goat skin transferring countries (Devi *et al.*, 2014). Fibres which will be employed in meat product area unit those extracted from orange, beet root, wheat, oat and pea. Scientific information concerning the adding of pea fibres to chicken nuggets couldn't be originate within the literature, however this fibre will be wont to

substitute extenders like soybean protein or starch, ordinarily helpful in meat product formulations (Garcia *et al.*,2002).

Nugget ready from chicken, chevon and cara beef or together with incorporation of vegetable protein and gum and it detached as a fast meal that is widespread selection of buyer. The acceptance of emptor for meat nuggets mainly depends upon sure factors like their taste property, nutritionary price, suitableness, protein quality and on the constancy of product. The superiority of nuggets will be significantly tormented by process, staple and ingredient factors. particularly fat content plays a crucial role in product options like flavour, appetisingness and texture similarly as technological properties, currently days skill of shopper concerning relation between diet and health they're hard for low fat and fibre enriched product. but merely reduction of fat in comminuted meat product leads to rubbery and dry rough-textured product (Keeton 1994) hence, there is want for exploitation appropriate ingredients that minimize the properties of fat in blended deep-fried meat product, it will be able to replace fat while not increasing caloric intake and while not poignant product quality (Buss 1993).

Several makes an attempt are created to develop product like meat balls, sausages and chicken meat hotdog (Babji *et al.*,1998; Biswas *et al*., 2004). Dietary pointers additionally advise a diet wealthy in fruit and vegetables for a healthy life vogue. World Health Organization (WHO) and worldwide health authorities like U.S Department of Agriculture (USDA) promote a high consumption of various selection fruit and vegetables. Natural dietary fibres sources area unit wonderful meat substitutes because of their inherent useful and nutritionary effects (Hur *et al.*,2009; Kumar *et al.*,2011).

Fibre intake through meat substituted with fruits, vegetables and grains is related to reductions in plasma and LDL-cholesterol, scale back the chance of major dietary issues like blubber, coronary diseases, diabetes, epithelial duct disorders, together with constipation, inflammatory internal organ diseases (Schneeman,1999).Dehydrated fruit, vegetable and cereal fibre may be utilized in the food business as purposeful ingredient with wonderful results (Viuda *et al.*, 2010) and its intake of fibre reduces the danger and promotes a health

(Kritchevsky,2000). Banana is a part of human diet for several years and is that the second most vital fruit crop in Asian country next to mango (Abano,2010).

Banana could be a fashionable having its low value and presence of high nutrients, inexperienced banana is packed with fibre and sensible for individuals with biological process and internal organ downside. It's particularly helpful for dilator. Metallic element facilitates in control pressure level. It's powerhouse of nutrient, that works effectively for diabetics. Developed hard pork sausages with reduced fat content by victimization dietary fibres from apple, peach and orange and cereal flours like wheat and oat (Garcia *et al.*,2002). Fat content in beef burgers may be reduced while not depreciative the standard of food through the utilization of fat substitutes viz, oat flour, apple peel flour, inexperienced banana pulp flour, inexperienced peel flour and inexperienced banana flesh (Bastos *et al.*,2014). Bologna sort sausages can be made by exchange fat up to sixty per cent with a mix of pork skin, water and inexperienced banana flour while not depreciative product quality (Larissa *et al.*, 2016). Some studies have shown pre-judicious impact of wheat and corn fibres on iron and metallic element absorption in animals and humans (Mason *et al.* 1990, Van Dokkum,1992).

Keeping in sight the large accessibility of chevon and utilization fruit fibre i.e., green banana pulp for development of purposeful and health promoting values study is planned to develop fibre enriched chevon nuggets with following objectives.

1) To standardize the levels of green banana pulp powder (2,4 and 6 percent) in the formulation of chevon nuggets.

2) To study shelf life of developed fibre rich chevon nuggets at refrigeration temperature (4 ± 1^0C).

Review of Literature

CHAPTER-II

REVIEW OF LITERATURE

Comminuted meat products normally contain a mixture of meat and non-meat ingredients. Processed meat products is mainly a consequence of the fast progress in urbanization and increased income among city dwellers. Most popular meat products like burger patties, meat balls (kofta), kabab, frankfurter type sausages and nuggets are produced from finely chopped meat emulsion.

2.1 Chevon meat

Naude and Hofmeyr (1981). found that, goat is the most prolific ruminant of all domesticated ruminants under tropical and sub-tropical conditions.

Murray *et al.*, (1997) observed that, in South Africa, processing of goat meat is similar to that of lamb; meat from young Boer goats competes with lamb.

Lechner *et al.,* (2001) noted that, due to the large ethnic populations within the Eastern USA and their consumer preference for goat meat, there is a great potential for farmers to market goat meat in this region.

Hur, *et al.,* (2009) noted that, emulsifier type on the micro-structural changes that occur to emulsified lipids. Emulsified lipids were then passed through an *in vitro* digestion model that simulated the composition (pH, minerals, surface active components, and enzymes) of mouth, stomach and small intestine juices. Physico-chemical and structural changes that may occur to emulsified lipids within the gastrointestinal tract, which may have important consequences for the design of functional foods.

2.2 Green Banana pulp powder

Beecher (1999) observed that, dietary fiber have been associated with both increased and decreased risk of chronic diseases. Phyto nutrients have been categorized into ten classes of compounds or biologic activities. Representative

compounds, typical biologic activities, and common food sources are tabulated for each phytonutrient class..

Garcıa (2002) noted that, addition of cereal and fruit dietary fibres on the sensory properties of reduced-fat, dry fermented sausages was studied. Dry fermented sausages with 6 and 10% pork back fat were manufactured, with addition of cereal (wheat and oat) and fruit (peach, apple and orange) dietary fibres, at 1.5 and 3% concentrations. The ripening process was monitored by physico-chemical and microbiological analysis.

Arvanitoyannis and Mavromatis (2009) reported that the physicochemical (pH, texture, Vitamin C, ash, fat, minerals) and sensory properties of banana were correlated with the genotype and growing conditions. Another issue relates to the beneficial properties of bananas both in terms of the high dietary fibre and antioxidant compounds, the latter being abundant in the peel.

Biswas *et al.,* (2011) observed that the Fibres are naturally occurring compound present in variety of vegetables, fruits, & act through their solubility, viscosity, water binding capacity, oil adsorption capacity, fermentability, mineral & organic molecule binding capacity which affect product quality & characteristics. High-fibre contain reduce risk of colon cancer, obesity& cardiovascular diseases.

Abbas *et.al.,* (2011) assessed Banana pulp and peel flour, prepared from green and ripe Cavendish banana for physicochemical properties such as pH, total soluble solids (TSS), water holding capacity (WHC) and oil holding capacity (OHC) at 40, 60 and 80 °C and viscosity. All statistical analyses showed that physicochemical properties of flour prepared from pulp and peel, and green and ripe banana were different from each other.

Biswas *et al.,*(2011) observed that, Fibers are naturally occurring compounds present in variety of vegetables, fruits, cereal flours etc. in abundance, and act through their solubility, viscosity, gel forming ability, water-binding capacity, oil adsorption capacity, fermentability, and mineral and organic

molecule binding capacity. fibers can help to improve colour, texture and sensorial characteristics instead of nutritional benefits.

Dhingra *et al.,* (2012) reported that the Dietary fibre is that part of plant material in the diet which is resistant to enzymatic digestion which includes cellulose, non-cellulosic polysaccharides. The diets rich in fibre such as cereals, nuts, fruits and vegetables have a positive effect on health since their consumption has been related to decreased incidence of several diseases. Dietary fibre can be used in various functional foods like bakery, drinks, beverages and meat products. Influence of different processing treatments (like extrusion-cooking, canning, grinding, boiling, frying) alters the physico- chemical properties of dietary fibre and improves their functionality.

Kumar *et al.,* (2012) reported that the all parts of the banana plant have medicinal applications, the flowers in bronchitis and dysentery and on ulcers; cooked flowers are given to diabetics ; the astringent plant sap in cases of hysteria, epilepsy, leprosy, fevers, hemorrhages, acute dysentery and diarrhea, and it is applied on hemorrhoids, insect and other stings and bites; young leaves are placed as poultices on burns and other skin afflictions; the astringent ashes of the unripe peel and of the leaves are taken in dysentery and diarrhea .

Pragati *et al.,* (2014) noted that the banana flour is an excellent alternative to minimize post-harvest losses and to retain the nutritive value of fresh bananas. Unripe banana flour is rich in resistant starch, dietary fibre, and aids in colon health. Ripe banana flour contains high amount of iron calcium, potassium and reducing sugars which helps in better blood circulation.

Bastos (2014) developed a type of hamburger meat product and evaluate the physical features and sensory formulations of oat meal flour, flour of green banana pulp, flour of green banana peel, flour of apple peel and pulp of Green Banana as fat substitutes. green banana differed from others, resulting in a higher yield of burgers and water-holding capacity during cooking.

Larissa *et al,* (2016) studies the effect of pork skin (PS) and green banana flour (GBF) on the physicochemical, technological, microbiological, and sensory properties of Bologna-type sausages was assessed. Lower cooking loss and higher emulsion stability ($P<0.05$) were observed in the modified treatments, healthier Bologna type sausages could be produced by replacing up to 60% of the fat with a mixture of PS, water, and GBF without depreciating product's quality.

Thakur *et al.,* (2016) noted that the Unripe green banana flour by pre-treatment of banana slices with sodium meta bisulphite followed by cabinet drying method, produced a flour with fairly white colour, good nutritive value and yield was about 26 per cent. Proximate composition and functional properties such as bulk density, water. absorption. capacity, swelling capacity, foaming capacity, emulsification capacity and rehydration characteristics of prepared banana flour.

Chakraborty, *et al.,* (2017) observed that banana is a good source of polyphenols, carotenoids and rich in dietary fibre, proteins, essential amino acids, polyunsaturated fatty acids and potassium. The raw and ripe banana peels were used for the development of products such as bread and noodles. The antioxidative property of polyphenols will also prevent lipid oxidation in the food products which causes rancidity, off flavour which leads to reduction of shelf life and nutritive value of food.

Costa *et al.,* (2017) noted that the green banana pulp added to the yogurt stimulated the multiplication of *L.acidophilus* after the first day of fermentation and *B.Sbifidum* after seven days in cold storage compared to the control that consisted of yogurt without the addition of green banana pulp. The dose-response effect was not observed; however, the results show that the green banana pulp has a prebiotic potential without interfering with either the physicochemical or sensorial characteristics.

Salim *et al.,* (2017) observed that the Fruit and vegetables, are highly perishable biological materials contributed to the higher food waste compared to other commodity. the potential utilization of abundance of seasonal crop and also

by-products of fruit and vegetable using appropriate technologies for the conversion of food wastage into value added products.

De Souza *et al.,* (2018) used green banana puree (GBP) to replace fat at different levels. Sensory profile by Check-All-That-Apply (CATA) tests and acceptance were applied to settle the best formulation in each step. replacing fat with GBP causes changes in color, slice size, compaction, and some attributes of odour, flavor, and texture.

2.3 Preservatives

2.3.1 Chemical Preservatives

(a) Salt

Pearson and Gilllett (1996) observed that salt contribute to flavor, preservation, increase moisture retention, ionic strength and solublisemyofibrilar proteins thus, enhancing protein binding.

Smith (2001) reported that in post rigor muscle, salt dissociated actomyosin into actin and myosin, thus increased the water holding capacity and improved texture of meat. He observed that when salt is utilized in restructured products, the salt soluble proteins under goes coagulation and ensures binding of the product together into a cohesive matrix. Addition of salt to processed meat products also accelerates oxidation.

Pawar *et al.* (2005) observed that the pro-oxidant activity of salt accelerates the rate of oxidation in goat meat patties resulting in production of off flavour. It was advocated to use salt in combination with STPP rather than alone to prevent oxidation.

Desmond (2006) reported that in modern meat industry salt is used as a flavor enhancer and is also responsible for the desired textural properties of processed meat.

Rindhe (2008) observed that the flavour and overall palatability scores were optimum in cooked chicken sausages with 1.9 per cent salt without having any adverse effect on other sensory

Gaelle *et al.,* (2019) found that, major consumer concern about dietary salt intake worldwide. However, even with the development of contemporary preservation practices, sodium chloride is still essential in processed meat products.

(b) Sodium tripolyphosphate (STPP)

Rubin *et al.,* (1990) noted that, curing adjuncts like Sodium tripolyphosphate (STPP) and Sodium ascorbate form an effective and highly synergistic antioxidant combination .

Claremaria *et al.,* (2004) prepared nuggets using equal portion of breast and thigh chicken meat with addition of 0.25 % Sodium tripolyphosphate (STPP). They reported that with incorporation of STPP in control and supplemented minced meat, the effect of antioxidant was reduced to a significant degree.

Lamkey *et al.,* (1986) observed that, stated that polyphosphates are added not only to improve the sensory quality of meat products but also prevent discoloration and developments off flavour when used in combination with salt.

Kim, *et al.,* (2018). Found that, effect of adding sodium tripolyphosphate (STPP) and canola oil on the quality traits of chicken nuggets. The nuggets were prepared from the breast meat of 75-week-old Hy-line old layer. Texture and overall acceptance were significantly increased with the increase in canola oil content in a test based sensory evaluation. In conclusion, adding 0.3% STPP and 15% canola oil to chicken nuggets made from the old layer could produce a product with an acceptable quality.

2.3.2. Natural preservative

(a) Spices and Condiments

Lee *et al.,* (1986) Noted that, Natural spices and condiments such as cinnamon leaves, red chilli, turmeric, black pepper, cloves, onion, garlic and ginger have antioxidant properties

Padda *et al.,* (1988) Observed improvement in flavour and overall acceptability of goat meat balls with incorporation of 5-7.5% onion paste, 1-2% garlic and ginger paste or 5-7.5% of mixed green curry stuff containing 6% onion, 2% garlic and 2% ginger paste.

Naveena and Mendiratta (2001) effectively utilized the ginger extract in cooking by which the shelf life of beef and pork was extended during storage, even without refrigeration. Ginger extract treatment caused two fold increases in shelf life of pre-cooked; saram wrapped lean beef at 4^{o}C. They also reported increase in shelf life of mutton and chicken meat cuts treated with ginger, onion and sodium chloride by inhibiting the microbial growth.

Rajkumar and Berwal (2004) documented antimycotic and antioxidant activity of clove and other species for preservation of pastima made from boneless chevon and recorded the shelf life up to 15 days at 4 ± 1 ˚ C.

Costa *et al.* (2018) noted that, powdered condiment with tucupi, as well as to assess the product's sensory acceptability and its hygroscopic behaviour. The powdered tucupi used in the formulation of the condiment was obtained by drying in a spray dryer. The product underwent sensory evaluation for its acceptability regarding the attributes of color, aroma, flavor, and overall impression and a purchase intention test was applied by hedonic scale. The acceptability index was 80% for overall impression and the purchase intention test indicated that 94% of the judges would be willing to buy the product.

Schaarschmidt (2016) found that dried spices and culinary herbs are vulnerable products, which are used for their aroma and colour. They are

important ingredients in many processed foods, e.g. meat products,and bakery products, and in most of our dishes.

2.4 Non meat ingredient

2.4.1. Refined Wheat flour

Verma *et al.,* (2014) Noted that, in noodles formulation refined wheat flour was replaced with chicken meat at three levels viz. 30, 40 and 50 percent. The control (without meat) was prepared and compared with chicken meat noodles. Noodles were evaluated for various physico-chemical and sensory properties.

Jamaly *et al.* (2017) Studied effects of different levels of wheat flour as dietary fiber on the quality of fresh and preserved beef meatballs during storage.

Choe and Kim (2019) observed that, chicken skin and wheat fiber mixture (**CSFM**) as an optimal fat replacer and its addition levels in reduced fat emulsion-type sausages, Emulsion stability and pH were not significantly affected, higher moisture and lower fat content were observed in the sausage samples without protein content loss.

2.5Quality parameters

2.5.1. Proximate composition

Reddy and Malika (2004) observed decrease in moisture from 55.63% to 53.52% in desi duck meat nuggets during refrigerated storage for 16 days.

Anjaneyulu *et al.* (2006) noted significant increase in moisture content but decrease in fat content during storage of chicken nuggets and patties incorporated with 5% soy paste.

Kandeepan and Biswas (2007) observed decline in moisture, protein and fat in buffalo meat stored at chilling temperature.

Williams, (2007) reported that moisture content of fresh lean mutton, lamb and beef meat were 73.2, 72.9 and 73.1 percent respectively. Fat content of fresh lean mutton, lamb and beef meat were 4, 4.7 and 2.8 per cent respectively.

Zargar *et al.*, (2014) Studied that crude protein content of chicken sausages decreased significantly ($p<0.05$) with lean meat replacement, however, reduction was not significant ($p>0.05$) between the variants prepared by incorporation of 12 and 18 percent levels of pumpkin. At 18 percent level it was significantly ($p<0.05$) lower as compared to control.

Ores *et al.*, (2018).Noted that, meat content and the wheat fiber proportions in the mass then evaluated. Buffalo meat incorporation did not affect the pH and moisture content during the ripening period, nor the proximate composition of the final product, only increased the protein content of the fermented sausages.

2.6 Physico-chemical characteristics

2.6.1. pH

Naveena and Mendiratta (2004) observed pH value did not differ significantly between control and ginger extract treated samples. However, values were slightly higher for treated samples compared to control, which might be due to higher pH of ginger extract.

Das *et al.* (2008) reported that incorporation of soy granules and soy paste in chevon nuggets resulted in increased pH of chevon nuggets.

Rindhe (2008) reported that pH of cooked chicken sausage increased significantly with increase in whey protein concentrate as binder.

Kilic *et al.* (2010) observed that average value of Turkish meatball was increased with gradually addition of TSP.

Devendra *et al.* (2015) studied that innate pH of FMF, cassava flour in frankfurters having no change.

Furtado *et al.,* (2019) reported that, physicochemical characteristics of the porcine longissimus dorsi (LD) muscle was evaluated in comparison to the standard methods of pH and color for meat quality analysis compared to the pH results with Colorimeter and pH meter.

2.6.2. Cooking yield

Sakunde (2004) observed significant improvement in cooking yield of chicken patties with incorporation of 3 % WPC.

Ruban *et al.,* (2007a) revealed significant improvement in cooking yield of pork sausage incorporated with 7 % potato flour which was followed by 5 and 3 % levels.

Sudha *et al.,* (2008) studied that product yield of pork patties increased progressively with increased inclusion levels of whole egg liquid.

Ikhlas *et al*,.(2011) revealed the cooking yield of quail meat ball using potato flour was highest (98.97%), followed by the yields of meat balls cooked using cassava (97.99%), sago (97.46%), corn (91.06%) and wheat flour (91.00%).

Devendra *et al.,* (2015) observed that the ($P < 0.05$) higher for the Finger millet flour-patties as compared to the control.

Anderson *et al.,* (2001)Raw and cooked samples were weighed and analyzed for moisture, fat, and protein content. Fat retention and cooking yield were calculated.

2.6.3. Emulsion stability

Ruban *et al.,* (2007a) revealed that emulsion stability of pork sausage incorporated with 7 and 10 % tapioca starch was significantly lower ($P<0.01$) than that of 3 % level while the emulsion stability of pork sausage incorporated with 7 % potato flour was highest followed by 5 and 3 % level.

Das *et al.,* (2008) reported addition of soy proteins did not significantly affect emulsion stability and product yield of chevon nuggets.

Ponsingh *et al.,* (2010) reported that 7% potato flour had better emulsion stability and cooking yield to other levels of potato flour (i.e. 3 % and 7%) for sausages.

Zargar *et al.,* (2014) observed that incorporation of pumpkin in chicken sausages, emulsion stability decreased significantly ($p<0.05$) at 12 and 18 percent level of pumpkin in comparison to control.

Devendra *et al.,* (2015) studied that, the emulsion with 4% and 6% Finger millet flour shows that ($P <0.05$) higher emulsion stability with 2% Finger millet flour.

2.6.4. Texture analysis

Das *et al.,* (2008). found that, the use of full-fat soya paste (FFSP) in development of goat meat patties increased the moisture and fat contents, but decreased the protein, shrinkage, hardness, springiness, chewiness, and shear force values

Devatkal *et al.,* (2003) observed that the hardness, gumminess, chewiness, cohesiveness, springiness is increased in the chevon nuggets prepared with the carrot in comparison to control.

Devendra *et al.,* (2015) the instrumental texture profile attributes like hardness, springiness, stringiness, chewiness and gumminess decreased significantly ($P<0.05$) in Finger millet flour incorporated patties, whereas cohesiveness and resilience were comparable to the control.

Baugreet, (2018) textural assessment showed that elevating protein level increased hardness, chewiness, cohesiveness, and gumminess in cooked restructured steaks. LF addition reduced all textural values assessed, indicating a strong plant protein effect on texture modification. The commercial binder produced a better bind in combination with protein ingredients.

2.7 Sensory quality

Labell, (1987) Reported that, increase in flavour of microwaved meat and poultry treated with 2% ginger powder.

Alamanou *et al,*. (1996) Observed that Aroma and flavour are the most important attributes that influences sensory qualities of comminuted meat products.

Rao *et al.,* (1999b) Stated that incorporation of WPC resulted in significant improvement in sensory scores in respect of flavour, juiciness, texture and overall palatability of smoked chicken sausage.

Kumar *et al.,* (2000) Observed that colour, flavour and overall acceptability scores were better in spent hen meat product made with incorporation of 7.5% whey protein concentrate (WPC) as compared to other levels of WPC.

Pawar *et al.,* (2002) Revealed that chevon patties made with incorporation of 10% fat and 20% WPC and cooked in hot air oven had better overall acceptability score as compared to other methods of cooking.

2.8 Shelf life

Cremer and Chipley, (1977) Reported that the microbial count of log 4.6 for psychrophills and 5.33 cfu/g for TPC is considered to be indicative of unacceptable cooked meat products.

Greene and Cumuze, (1982) Reported that the increase in TBA values particularly at the end of storage is indicative of oxidative rancidity but the values on 20^{th} day were within the spoilage limit of 0.60 mg/Kg where the off flavours are generally detected in the product.

Das and Jayaraman, (2003) Studied quality and stability of convenience dehydrated chicken pulav and found non-significant increase in moisture and decrease in fat content of the product packed in PP and PFP during storage up to 10 months at both the temperatures viz. 27 ± 4^0C and 4 ± 2^0C.

Sakunde, (2004) Reported 20 days shelf life of chicken patties made with incorporation of 3 % WPC as well as control when packed aerobically in aluminium foil and stored at 4 $\pm$ 1^{o}C.

Rindhe, (2008) observed that the 20 days shelf life during refrigerated (4±1°C) storage of cooked chicken sausages incorporated with 2% WPC and 4% SMP

Naveena *et al.*, (2008) noted that, chicken patties were treated with pomegranate, cooked to an I.T. of 80 °C, and stored in low-density polyethylene pouches for 15 d at 4 °C. TBARS value for control was reported as 1.272 ± 0.13 mg MDA/kg meat, and the treatment with pomegranate rind powder had a TBARS value of 0.203 ± 0.04 mg MDA/kg. TBARS values also decreased 68% (pb0.05) compared with samples treated with BHT (100 mg BHT/100 g meat) for the same product held under identical storage conditions. TBARS mean values for BHT samples were 0.896 ± 0.12 mg MDA/kg meat.

Bargaje (2009) while studying the development of chevon nugget incorporated with spent hen meat observed that chevon nuggets with or without WEL or soy flour could be stored safely in HDPE pouches for 28 days under refrigerated storage at 4 ± 1^{0}C.

Vaithiyanathan *et al.*, (2011) evaluated the effect of pomegranate fruit juice phenolics (PFJP) dipping solution on the shelf life of chicken meat held under refrigerated storage at 4 °C. TBARS were evaluated in 2-d intervals for 28 d and it was reported that TBARS values were lower in samples treated with PFJP.TBARS values ranged from 0.51 to 1.07 and 0.35 to 0.75 mg MDA/kg of meat, respectively in samples treated without PFJP and with PFJP during storage period. A 5-member experienced panel evaluated the breast meat samples and scores indicated that both samples treated with and without PFPJ performed well in all sensory attributes (appearance, color, odor, off odor). However, on day 4 sensory attribute scores of samples without PFJP started to decline while scores of samples with PFJP remained high. Additionally, the acceptability scores of

samples treated without PFJP decreased significantly (pb 0.05) on day 12 of storage.

Biswas *et al.,* (2011) concluded that patties prepared from spent duck meat were acceptable up to 7 days at refrigeration temperature.

Ibrahim *et al.,* (2011) studied that comparison of control and treated lamb patty samples during storage at 4 ^{0}C for 9 days showed that the addition of the investigated natural plant extracts (Ginseng, Jatropha, jojoba and ginger) was effective as antioxidant and microbial agent for improving the properties of lamb patties.

Iheagwara, (2013) reported smoked fish treated with ginger extract were stored for 20 days at ambient temperature.

Zargar *et al,*. (2014) Studied that the sausages prepared with the incorporation of 12 percent pumpkin and control were packed aerobically in low density polyethylene (LDPE) pouches and were kept at refrigeration temperature (4±1^{0}C). These pouches were opened under hygienic conditions at a regular interval of 0, 7, 14 and 21 days (till spoilage) for analyzing the different physicochemical, microbiological and sensory properties.

2.8.1 Physico-chemical changes

(a) pH

Reddy and Mallika (2004) observed increase in pH from 5.87 to 6.09 but decrease in moisture from 55.63 to 53.52 % in desi duck meat nuggets during refrigerated storage of 16 days.

Sakunde, (2004) revealed significant increase in pH during 21 days refrigerated storage (4 ± 1^{o}C) of chicken patties made by incorporating different binders while the fat, protein and moisture content reduced significantly.

Sangtam *et al.,* (2005) observed that pH of mutton nuggets increased significantly on 20th day of refrigerated storage (4 ± 1 ^{0}C).

Ambadkar *et al.,* (2006) reported non-significant (P>0.05) variations in pH upto 21 days of refrigerated storage of lactate treated buffalo meat cooked Salami but the gradual decline was noticed in moisture content.

Biswas *et al., (*2011) observed that the pH of duck patties significantly increased (p<0.01) at ambient temperature and highly significant (p<0.01) with decrease in the pH after 7^{th} day at refrigeration temperature.

Ibrahim *et al.,* (2011) observed increased in pH of the control and treated lamb patties containing natural antioxidant extract were significantly (*p*<0.05) increased gradually throughout the storage period.

Chandralekha *et al.,* (2012) observed that overall mean pH values of chicken meatballs incorporated with 5 percent pomegranate rind powder extract had significantly (p<0.05) lower values than the other formulations and the pH was increased significantly (p<0.05) during refrigerated storage for 8 days which might be due to the accumulation of metabolites by bacterial action in meat in addition to protein and amino acid degradation resulting in formation of ammonia and consequent increase in pH.

Hafid *et al.,* (2018) found that chicken intestines have no significant effect (p>0.05) to pH, cooking loss and yield nuggets produced. PH range nuggets ranged from 6.46 to 6.60. Cooking loss range obtained in this study were between 2.22-20%. The range of yield values generated nugget is between 129.2 to 133.9. It can be concluded that the substitution of chicken intestine showed pH, cooking loss and product yield nuggets are relatively uniform in all treatment combinations were tested.

(b) Thiobarbituric acid value (TBA value)

Reddy and Rao, (2000) showed that addition of bengal gram flour and black gram flour at 20% level replacing meat resulted in increased TBA values during refrigerated storage of 12 days.

Devatkal *et al.,* (2003) demonstrated that microbial growth and oxidative rancidity resulted in flavor deterioration in restructured pork rolls during storage.

Reddy and Mallika, (2004) observed increase in TBA values during refrigerated storage of desi duck meat nuggets for a period of 16 days.

Sangtam *et al.,* (2005) observed that TBA values of mutton nuggets increased significantly on 20^{th} day of refrigerated storage as compared to fresh product.

Brewer *et al.,* (1992) observed that faster lipid oxidation of product. The products were acceptable and did not show any perceivable rancidity or off odour up to 20 days.

Vaithiyanathan *et al.,* (2011) reported that TBA value in spent layer breast muscle increased over a period of storage at refrigeration temperature which varied from 0.55 to 1.90.

Rindhe, (2008) observed that the TBA value increased significantly ($p<0.05$) during refrigerated (4 ± 1 °C) storage of cooked chicken sausages incorporated with 2% WPC and 4% SMP.

Ponsingh *et al., (*2010) revealed that during storage of buffalo meat sausage incorporated with potato flour, there was significant ($p<0.01$) increase in Thiobarbituric acid reactive substance.

Biswas *et al.,* (2011) revealed no significant difference in the TBA values of duck patties stored at refrigeration temperature at 0, 3^{rd} and 7^{th} day.

Ibrahim *et al.,* (2011) reported that the natural extracts were effective as antioxidants and had lower TBARS values than the control patties throughout the storage period.

Baker *et al.,* (2013) Studied that TBA value of patties in the control started to increase significantly ($p<0.01$) from 1.75(day 1) to reach 3.84 mg MDA /kg meat at the end of storage period. While, the maximum values for lamb patties treated with ginger extract (GE) or ginger extract + sodium lactates were1.32 and 1.19 mg MDA/kg meat at the end of storage period.

Iheagwara (2013) reported that the second stage of auto oxidation, during which the peroxides are oxidized to aldehyde and ketones, which impart the disagreeable fishy or rancid odours and flavour.

Zargar *et al.,* (2014) observed that the thiobarbituric acid reactive substance value significantly ($p<0.05$) increased from day 0 to 21 in case of both control as well as treated sausages.

Barber *et al.,*(2020). Thiobarbituric acid value (TBA) and sensory properties of Piper guineense and Monodoramyristica oleoresin spiced chicken-breadfruit patties at refrigerated storage for four weeks were evaluated.

(c) Tyrosine value

Dainty *et al.,* (1975) observed increase in tyrosine, tryptophan, ammonia and NPN due to increased microbial activity since the microorganisms usually produce proteolytic enzymes in late logarithmic phase of growth.

Strange *et al.,* (1977) reported that tyrosine value is an indicator of proteolysis as it measures tyrosine and tryptophan in the non-protein extract of meat.

Naveena *et al.,* (2001) observed increase in tyrosine value in smoked spent hen meat treated with ginger extract due to proteolysis when stored at room temperature.

Jayesh and Venkataramanujam, (2002) reported that the protein degradation (tyrosine value) increased gradually in mutton during chilling with the progress of storage.

Kandeepan and Biswas, (2007) observed that extract release volume (ERV) water holding capacity (WHC) and proximate composition of buffalo meat decreased with increasing storage period while pH, TBA number and tyrosine value increased with progress of storage period at refrigerated temperature.

Ruban *et al.,* (2008) observed significant increase in tyrosine value during storage at refrigerated temperature and the tyrosine value was higher in sausages incorporated with potato flour than that incorporated with tapioca flour.

Suradkar, (2008) reported steady decline in moisture, fat and protein content of chicken nuggets during refrigerated storage. However, the pH, TBA, and tyrosine content increased considerably with the progress of storage.

Rindhe *et al.,* (2009) observed that the moisture, protein and fat content declined significantly during storage of cooked chicken sausages while pH, TBA and tyrosine values increased significantly.

Rathod, (2005) observed that significantly increased in peroxide value of hurdle processed chicken curry (4.89 to 44.57 meq O_2 /kg fat) was recorded with the progress of storage period.

Iheagwara, (2013) reported significantly increased in peroxide value in all the treatments during 20 days storage. The highest value (30.07 mEq /kg) of peroxide was recorded for the control, while the lowest value (4.50mEq/kg) was observed in the treated samples.

2.8.2 Microbial changes

Vonholy and Holzaptel, (1991) reported that the total viable count of food samples at the end of storage was below the incipient spoilage limit of 6.70/g.

Sakunde, (2004) reported that the standard plate count was significantly low in patties prepared with addition of 3% WPC as compared to control during the entire storage period at 4^{o}C.

Yadav and Sharma, (2004) Observed that standard plate count (SPC) of control and WPC (4%) treated chevon rolls ranged between 3.34 to 3.75 log cfu/gm on 0 day which increased significantly to 4.5 log cfu/gm on 5^{th} day of refrigerated storage.

Sangtam *et al.,* (2005) observed that total plate count and psychrophilic count of mutton nuggets was increased significantly on 20^{th} day of refrigerated storage ($4 \pm 1\ ^{0}C$).

Anjaneyulu *et al.,* (2006) reported significant increase in total plate count during refrigerated storage of chicken nuggets and patties incorporated with 5% soy paste.

Ruban *et al.,* (2007^{b}) Revealed that total viable count and psychrophilic count of sausage made with incorporation of 5 % level of potato flour were lowered during refrigerated storage.

Rindhe, (2008) Observed that the Total plate count and Psychrophillic count increased significantly ($p<0.05$) during refrigerated (4±1°C) storage of cooked chicken sausages incorporated with 2% WPC and 4% SMP.

Kumar and Tanwar, (2011) Reported thatantimicrobial effect of clove powder as microbial load in optimized preparation of chicken nuggets was found to be significantly ($P<0.05$) lower throughout the storage period when compared with control chicken nuggets.

Baker *et al.,* (2013) revealed that in untreated lamb patties were a significant rise in total plate count, coliform, psychrophlic count during storage period but addition of rosemary, ginger and their combination with sodium lactate resulted in a marked significant ($p<0.01$) reduction on all count of studied bacteria.

Mohammed, (2019). average bacterial load of the fresh and frozen samples for camel meat were (3.5 x 10-6 and 2.5 x 10-6 CFU/ gm). Also the result in this study showed the total bacterial count in beef samples were (2.5 x 10-5 and 1.5 x

10-5 CFU/gm) and for the samples of goat meat were (2 x 10-6 and 1.5 x 10-6 CFU/gm). In general there was considerable decrease in the bacterial count with increase in storage period. The study also showed that there was a decreased in the number of bacteria with freezing storage period.

2.8.3 Sensory quality

Suresh *et al.,* (2003) reported that deterioration of flavour during storage might be due to microbial growth and oxidative rancidity.

Sakunde (2004) reported that flavour, Juiciness, texture and overall acceptability scores of chicken patties did not differ significantly up to 5^{th} day but afterwards decreased significantly throughout refrigerated storage period of 20 days.

Yadav and Sharma (2004) observed non-significant differences in colour, juiciness, gumminess, tenderness and overall acceptability scores in control as well as in WPC (4%) treated chevon rolls up to 10^{th} day of refrigerated storage.

Rindhe, (2008) observed that flavour, Juiciness, texture and overall acceptability scores of cooked chicken sausage did not differ significantly up to 5^{th} day but afterwards declined significantly throughout refrigerated storage period of 20 days.

Anna *et al.,* (2010) noticed no adverse effects on sensory scores of smoked buffalo tripe rolls for appearance, flavour, juiciness, texture and overall acceptability up to 21^{st} day of storage at refrigerated temperature.

Biswas *et al.,* (2011) observed that significant ($p<0.01$) decrease in colour scores of duck patties on 14^{th} day as compared to 0 day and 21^{st} day as compared to 0, 3and 7 days at refrigeration temperature.

Baker *et al.,* (2013) studied that sensory evaluation of the lamb patties during storage period. The overall acceptability, colour and flavour of products was highest ($p<0.01$) in treated with ginger extract, rosemary extracts and sodium lactate as compared with the control patties at the end of storage period.

Bobko *et al.,* (2018).sensory quality indicators after grape seed extract we did not record statistically significant differences (P> 0.05) between individual groups, indicating that the sensory quality of raw cooked meat products was not negatively affected by their addition. In the evaluation of the most important indicator of sensory quality (taste) we recorded better average ratings in all experimental groups with the addition of grape seed extract than in the control group. Based on the results of the oxidative stability and sensory quality of the raw-cooked meat product after 10 days of refrigerated storage at 4 °C, we can recommend using natural antioxidants in the production of the meat product in the form of grape seed extract Dunaj, Frankovka modra and Cabernet Sauvignon to increase oxidative stability thereby increasing the shelf life and sensory quality of the raw cooked meat products.

Materials And Methods

CHAPTER-III

MATERIAL AND METHODS

3.1 Raw materials and sources

3.1.1 Goat meat

The goat meat was obtained from both hind legs of carcass of good confirmation from non-descriptive adult male goat slaughtered by traditional halal method from local market of Udgir city and packed in LDPE pouches and brought to Laboratory Department of Livestock Products Technology, College of Veterinary and Animal Sciences, Udgir. Optimum care has been taken at the time of transportation of meat to avoid contamination.

The body fat, tendons and separable connective tissues were trimmed off. The dressed meat was packed in polyethylene pouches and kept in a refrigerator for 12 hrs at -18 $\pm$ 1^{o}C which was thawed then subsequently used for product preparation.

3.1.2 Common salt and vegetable oil

Food grade common salt and refined sunflower oil required for formulation of chevon nuggets were purchased from local market of Udgir .

3.1.3 Chemicals

All the chemicals of analytical grade were procured from standard firms.

3.1.4 Spice mixture

Spice ingredients viz., black cardamom (Badielaichi),cinnamon (Dalchini), turmeric (Haldi), cloves (Laung), red chilli (laal mirch), coriander powder (Dhania), cumin seeds (Zeera), black pepper (Kali mirch) and aniseed (Soanf) purchased from the local market. All the spice ingredients were cleaned to remove extraneous matter After removal of extraneous matter all spices dried in oven at 60^{0}C for overnight and then ground in grinder to powder. The course

particle removed using the sieve and fine powder spices mixed in a required proportion to obtain spices mix which stored in airtight plastic container for subsequent use.

The powdered mixture having required proportion of each ingredient as shown in Table 3.1(Verma *et al.,* 2010 with slight modification) was used for preparation of chevon nuggets.

Table 3.1 Composition of spice mixture

Sr. No.	Spice ingredients	Quantity percent (by weight)
1.	Black cardamom (Badi elaichi)	05
2.	Cinnamon (Dalchini)	20
3.	Turmeric (Haldi)	10
4.	Cloves (Laung)	05
5.	Red chilli (laal mirch)	10
6.	Coriander powder (Dhania)	20
7.	Cumin seeds (Zeera)	10
8.	Black pepper (Kalimirch)	10
9.	Aniseed (Soanf)	10
	Total	**100**

3.1.6 Refined wheat flour

Refined wheat flour or Maida (RWF) of standard brand was procured from local market.

3.1.7. Green banana pulp powder

Green banana purchased from local fruits shop. The fruits manually peeled and the edible portion (pulp) was cut into 5 mm slices and immediately rinsed in 1% citric acid solution for 10 min to prevent enzymatic reaction. Banana slices were washed repeatedly with tap water and after draining off excess liquid, dried in a hot air oven at 60 ± 2 ˚C till constant moisture content. After dehydration, the slices ground in powder form and stored at refrigeration temperature of 4 °C in a pre

sterilized low density polyethylene bags for further use. Karthikeyan, (2015) and Kumar *et al*., (2011).

3.1.8. Packaging materials

Low density polyethylene films were purchased from local market and used for packaging of the product. The packaging materials was pre-sterilized by exposing to U.V. light for 30 minutes before use.

3.2 Formulation of chevon nuggets

Cooked Chevon nuggets was prepared as per method of the Nayak *et al.*, (2015) with slight modification was used for preparation of chevon nuggets throughout the study.

Table 3.2 Basic formulation of chevon nuggets

Sr. No.	Ingredients	Quantity (% by weight)
1	Minced chevon meat	55.00
2	Salt	01.80
3	Sodium tripolyphosphate	0.20
4	Refined oil	10.00
5	Ice flakes	14.00
6	Dry spices mix	3.00
7	GBPP/Refined Wheat Flour	04.00
8	Egg	9.00
9	Condiments	03.00
	Total	**100**

3.2.1 Preparation of chevon nuggets

Cooked Chevon nuggets was prepared as per method of the Nayak *et al.* , (2015) with slight modification. The body fat, tendons and separable connective tissues trimmed off and kept in deep freezer at (–18+1˚C) overnight and then thawed, and cut in the small chunk and minced in the mincer. The minced meat is

chopped in the bowl chopper and chevon meat nuggets prepared as per the following flow chart.

Flow diagram for preparation of chevon nuggets

Chevon nuggets were developed by incorporating either 4% refined wheat flour (control) or 2%, 4% and 6% green banana pulp powder (treatment) separately (Plate 3.1, 3.2, 3.3 and 3.4). The formulation of emulsion was maintained by addition of water accordingly.

Frozen deboned goat meat (1kg)

↓

Overnight thawing (37 ℃)

↓

Cutting into smaller chunks

↓

Mincing through 6 mm plate

↓

Meat was chopped in bowl chopper (55%)

↓

Addition of salt & STPP (1.80 % & 0.20 %)

↓

Chopping

↓

Addition of water in the form of ice flakes (14%)

↓

Chopping

↓

Addition of vegetable oil (10%)

↓

Chopping

↓

Addition of spice mixture (3%), condiments mixture (3%) and green banana pulp powder(4%)/ refined wheat flour(4%)

PLATE 3.1 : CONTROL CHEVON NUGGETS USING REFINED WHEAT FLOUR

PLATE 3.2 : CHEVON NUGGETS USING 2% GREEN BANANA PULP POWDER

PLATE 3.3 : CHEVON NUGGETS USING 4% GREEN BANANA PULP POWDER

PLATE 3.4: CHEVON NUGGETS USING 6% GREEN BANANA PULP POWDER

↓

Addition of egg (9%)

↓

Chopping

↓

Emulsion

↓

Moulding of nugget

↓

Pressure cooking (15 psi)

↓

Cooling (37 ^{o}C)

↓

Sample Analysis ---------- Packaging----------Sensory evaluation

↓

Storage (4±1^{o}C)

3.3 Experiment details

3.3.2. Experiment 1: Standardization and selection of best variant of chevon nuggets incorporated with green banana pulp powder

Chevon nuggets were prepared separately by using the green banana pulp powder (2%, 4%, and 6%). The best quality of the cooked chevon nuggets decided on the basis of the sensory as well as physico chemical characteristics.

3.3.3 Experiment 2: Study on shelf life of cooked chevon nuggets.

Chevon nuggets prepared by using 4% green banana pulp powder and 4% refined wheat flour were stored at refrigeration temperature (4 ± 1˚ C) and assessed for changes in physico-chemical and microbiological quality at regular interval.

3.4 Analytical procedure

3.4.1 Physico-chemical Properties

The nuggets prepared under experiment 1 and 2 analysed for following physicochemical parameters.

3.4.1.1 pH

The pH of chevon nuggets was determined by the method of Trout *et al.* (1992). 10 g of cooked chevon nuggets was made into fine suspension with addition of 50 ml distilled water and the pH of suspension was measured using digital pH meter.

3.4.1.2 Thiobarbituric acid value

TBA value was determined as per the method as described by Witte *et al.*, (1970) with slight modification in the technique. Five ml of aliquot of TCA extract (as above) was mixed with 5 ml of TBA reagent in a test tube. The test tubes containing sample were kept in a water bath at 100^{o}C for 30 min along with control (a blank with 5 ml of 10% TCA and 5 ml TBA reagent). The optical density was measured at 530 nm using Spectrophotometer.

3.4.1.3 Tyrosine Value

Tyrosine value of chevon nuggets samples was estimated by the extraction method of Strange *et al.,* (1977).Twenty gm of meat sample was blended with 50 ml pre-cooled 20 % Trichloroacetic acid (TCA) for 2 min. The extract was obtained by filtering the content through Whatman filter paper No.42.TCA extract (2.5 ml) was added with equal amount of distilled water.To this freshly prepared 10 ml of 0.5 N NaOH solution was added. The mixture was kept for 10 min and then diluted Folin and Ciacaltleus reagent (1:2 with distilled water) was added. After mixing, it was kept in dark for 30 min.at room temperature for color development.

The absorbance (OD) was measured at 730 nm using Systronic Spectrophotometer. Tyrosine value was calculated as mg tyrosine per 100 g of meat sample by referring to the standard curve prepared as per the procedure of Pearson (1968).

3.4.2 Emulsion stability

Emulsion stability of chevon nuggets was determined as per the procedure of Baliga and Madaiah, (1971).

20 g of emulsion was placed in polyethylene bag (size 12 × 10 cm) and sealed airtight. The bags were heated in a thermostatically controlled water bath at 80^0 C for 30 min. The bags were removed from the water bath, cut at one end, cooked fluid was drained out and weighed. Weight after cooking was calculated and expressed as percent emulsion stability.

$$\text{Emulsion stability (\%)} = \frac{\text{Weight of cooked mass}}{\text{Initial Weight}} \times 100$$

3.4.3 Cooking yield

The weight of the chevon nuggets was recorded before & after each treatment and expressed in percent.

$$\text{Cooking yield (\%)} = \frac{\text{Weight of cooked chevon nuggets}}{\text{Weight of raw chevon nuggets}} \text{ x } 100$$

3.4.4. Proximate composition

The moisture, fat, fiber, protein, ash content of chevon nuggets were determined by following the method of AOAC (1995).

3.4.4.1 Moisture

Five gm of Chevon nuggets was transferred to hot air oven and dried at (100± 2^oC) until constant weight was observed in subsequent weighing and loss in weight was recorded as moisture content.

3.4.4.2 Fat

Fat content of chevon nuggets was estimated by Soxhlet extraction method. Moisture free sample was powdered and subjected to extraction using petroleum ether (60-80° C) in Soxhlet apparatus. The apparatus is allowed to run for sufficient period until the complete fat in the meat sample get dissolved in the petroleum ether. The ether extract was subjected to the hot air oven to remove petroleum ether from the extract completely and weighed as fat.

3.4.4.3 Fiber

Weight accurately about 3 gm of the material & extract the fat for about 8 hrs or use the residue from crude fat determination. transfer the sample into tall spoutless beaker with mark made at 200cc level. add 1.25% H_2SO_4 200cc in this beaker containing the fat free material, continue the boiling for 30 min. during the boiling to avoid foaming.

Filter the content of beaker in conical flask through muslin cloth held over the glass funnel. Wash the residue on muslin cloth in boiling water, till residue gets free from acid .Test with blue litmus paper. transfer the material from muslin cloth back to the original beaker. add 1.25% NaOH 200cc up to the mark & heat to boil for 30 min .filter the content of beaker through same muslin cloth on the conical flask. Wash residue with boiling water till residue gets free from alkali. Test with red litmus paper. transfer the residue to clean dry silica basin. Dry it at 100 ± 5^0C in hot air oven for 2-3 hrs, cool & wt. ignite the residue in muffle furnace at 600 ^{0}cfor 30 min. cooled and weighed.

3.4.4.4 Protein

Digestion: 2 gm sample transfer red kjeldahls flask. pour 25 cc of conc.H_2SO_4 .Add 1 gm of digestion mixture (K_2SO_4 & $CuSO_4$, 9:1) keep the flask in digestion chamber for 4 hrs till content become perfectly colourless or clear.

Distillation : transfer all the content of kjeldhals flask in volumetric flask. By adding d.w make the volume upto the mark then in receiving flask take about 20 cc for 2 % boric acid solution colour of solution become pink. as soon as the

steam pressur develops keep the receiver flask under the tip of condenser in such way that the tip of the condenser will dip completely in boric acid soln.10cc of aliquot in the funnel of distillation unit & release it slowly. Ammonia combines with boric acid to form ammonium borate. This gives green colours to the sol^{n}. this can be tested by red litmus paper.

Titration: Titrate this distillate against 0.1N HCl end point is green to violet or pink.note down the burret reading.

3.4.4.5 Ash:

The empty silica basin weighed accurately. About 2 gm of sample was taken in it and kept on heating coil for charring after weighing. Charing was continued till no fumes come out from the silica basin, after complet charring it was transferred to a muffle furnace having temperature of 600 ± 30^{0}c for 2-3 hrs. Greyish colour of the ash or two consecutive constant wt indicates the complete ashing.

3.4.5. Microbiological quality

The microbiological quality of chevon nuggets was assessed on the basis of total plate count (TPC), psychrophilic count and *Coliform* count at the end of storage as per the method of APHA (1992).

Preparation of serial dilutions:

1 g of aseptically packed chevon nuggets sample and 9 ml of 0.9 % sterile normal saline solution (NSS). Sample was Triturated in sterile mortar for uniform dispersion to get 10^{-1}dilution. Further serial ten-fold dilution was made in pre-sterilized tubes containing 9 ml of 0.9 % NSS water. All the dilutions were made near a flame by observing all possible aseptic precautions.

3.4.5.1 Total plate count

Plate count agar (23.5 gm) was suspended in one liter of distilled water and pH was adjusted to 7.0 ± 0.2. It was heated to dissolve completely and sterilized by autoclaving at 15 lbs pressure for 15 min.

Pour plate technique was followed for plating using 1 ml of inoculums in duplicate from appropriate dilutions. The plates were incubated at 37 ± 1 ^{0}C for 48 hrs. Following incubation, plates showing 30 to 300 colonies were selected for counting. The number of colonies were multiplied by the reciprocal of respective dilutions and expressed as $\log_{10}$cfu/g of sample.

3.4.5.2 Psychrophilic count

The procedure outlined for total plate count was followed for psychrophilic count the plates were incubated at 4 ± 1^{o}C for 7 days. Colonies were counted and results were expressed as $\log_{10}$cfu/g of sample.

3.4.5.3 *Coliform* count

37.46 g Eosin methylene blue agar (EMB) was suspended in 1litre of distilled water and boiled to dissolve the medium completely. Sterilize by autoclaving at 15 ibs pressure at 121^{0}c for 15 min. One ml of suitable dilutions was placed in sterile Petri dishes and overlaid with molten agar. After solidification, the plates were incubated at 37°C for 24 hr.

3.4.6 Sensory evaluation

The sensory panellists consisting of academic staff members from College of Veterinary and Animal Sciences, Udgir were involved to assess the quality of chevon nuggets on the basis of sensory attributes viz. appearance, flavour, juiciness, texture and overall acceptability using 8 point descriptive scale (Keeton,1983) where ‘8’ denoted extremely desirable and ‘1’denoted extremely poor. The stored product was observed for any objectionable flavour and colour

before evaluation. Chevon nuggets were warmed and then served hot to the sensory panellists for evaluation.

3.4.7 Statistical analysis

Data originated from various treatment groups were analysed statically using a Completely Randomized Design (CRD) by following standard methods Snedechor and Cochran, (1989). The analysis of data was done using SPSS software package version 20.0. variables having unequal observation were analysed following the least square design method and Duncan's multiple range test. Results were considered significant at the level of 95% ($p<0.05$) for comparison. Duncan's multiple range test provides significant level for the difference between any pair of means.

Results And Discussion

CHAPTER IV

RESULTS AND DISCUSSION

The present study was undertaken with a view to standardize the processing parameters for development of acceptable quality, fibre rich chevon meat nuggets with incorporation of green banana pulp powder and to assess its shelf life at refrigeration temperature. Results obtained during the study are delineated under following headings

- Appraisal of chevon nuggets with different level of GBPP.
- Shelf life of chevon nuggets during refrigerated storage. The result recorded during the experimental study are explained under the following headings.

4.1 Quality appraisal of chevon nuggets incorporated with various level of green banana pulp powder.

The preliminary trails were conducted to prepare acceptable quality of goat meat nuggets using green banana pulp powder (GBPP). GBPP incorporated at different levels (2%,4% and 6%) replacing proportion amount of goat meat & compared with the control (4% refined wheat flour). The best level of GBPP was selected for incorporation in chevon meat nuggets on the basis of sensory quality, proximate, emulsion stability& cooking yield

4.1.1 Sensory quality:

The average score for sensory attributes of chevon meat nuggets incorporated with different level of GBPP. (2%,4% and 6%) verses control (4% RWF) is presented in table 4.1.1.and fig.4.1

From table 4.1.1, It is revealed that there is significant ($p<0.05$) difference in all the sensory attributes viz. appearance, flavour, juiciness & texture except overall palatability.

The highest appearance score 6.90 was recorded for goat meat nuggets incorporated with 4% GBPP (T2) which was significantly higher than that of control (score 6.42) and treatments. While, the minimum score 6.57 as observed for chevon nuggets using 2% GBPP (T1) within treatments. This is due to incorporation of green banana pulp powder which causes darkening of colour and produces an overall higher appeal for chevon nuggets. Similar trend recorded by Kumar *et al.,* (2015) for chicken nuggets formulated with green banana and soyabean hulls and by Chatli *et al*. (2015), they recorded increasing trend of appearance score in emu meat nuggets incorporated with finger millet flour up to 6%.

The highest scores of flavours for chevon nuggets were recorded with incorporation of 4% GBPP (T2) (score 6.86) which was significantly higher than that of control (score 6.4) and treatments. Whereas, the lowest scores of flavours for chevon nuggets were recorded with addition of 2% GBPP (T1) (score 6.36) between treatments. Addition of 4% GBPP (T2) increase the score of flavour than treatment and control could be due to sweet fruity flavour. Similar finding were in close agreement with Aamina *et al*., (2014) for mutton nuggets incorporated with apple pomace and Kumar *et al.,* (2011) for chicken nuggets with green banana and soybean hulls flour.

The sensory scores of juiciness for the chevon nuggets differs significantly ($p<0.05$) up to addition of 4% GBPP (T2) than that of control and treatments. The highest juiciness score was recorded for goat meat nuggets incorporated with 4%GBPP (T2) i.e., 6.78 which was significantly higher than that of control (score 6.14) and treatments. However, the juiciness score was 6.24 for 6% GBPP (T3) and the lowest score was 6.08 for 2% GBPP (T1). The juiciness score of control was lower than 4% (T2) and 6% of GBPP (T3). The increase in juiciness could be due to the water holding capacity of products. Similar trend was recorded by Aamina *et al*., (2014) for mutton nuggets with apple pomace and contraindicated observations found in sheep meat nuggets with guava powder by Verma *et al*., (2013).

Table 4.1.1. Effect of green banana pulp powder on sensory attributes of chevon nuggets

Level of GBPP	Appearance	Flavour	Juiciness	Texture	Overall palatability
Control (4%RWF)	6.42±0.07^{a}	6.40±0.15^{a}	6.14±0.14^{a}	6.20±0.18^{a}	6.52±0.17
GBPP 2% (T1)	6.57±0.12^{ab}	6.36±0.16^{a}	6.08±0.17^{a}	6.36±0.26^{a}	6.42±0.12
GBPP 4% (T2)	6.90±0.12^{b}	6.86±0.07^{b}	6.78±0.08^{b}	7.00±0.17^{b}	6.86±0.19
GBPP 6% (T3)	6.70±0.11^{ab}	6.64±0.09^{ab}	6.24±0.17^{a}	6.56±0.11^{ab}	6.62±0.15
P.value	**0.036**	**0.040**	**0.013**	**0.042**	**0.272 (NS)**

Means with different superscripts differ significantly (P<0.05)

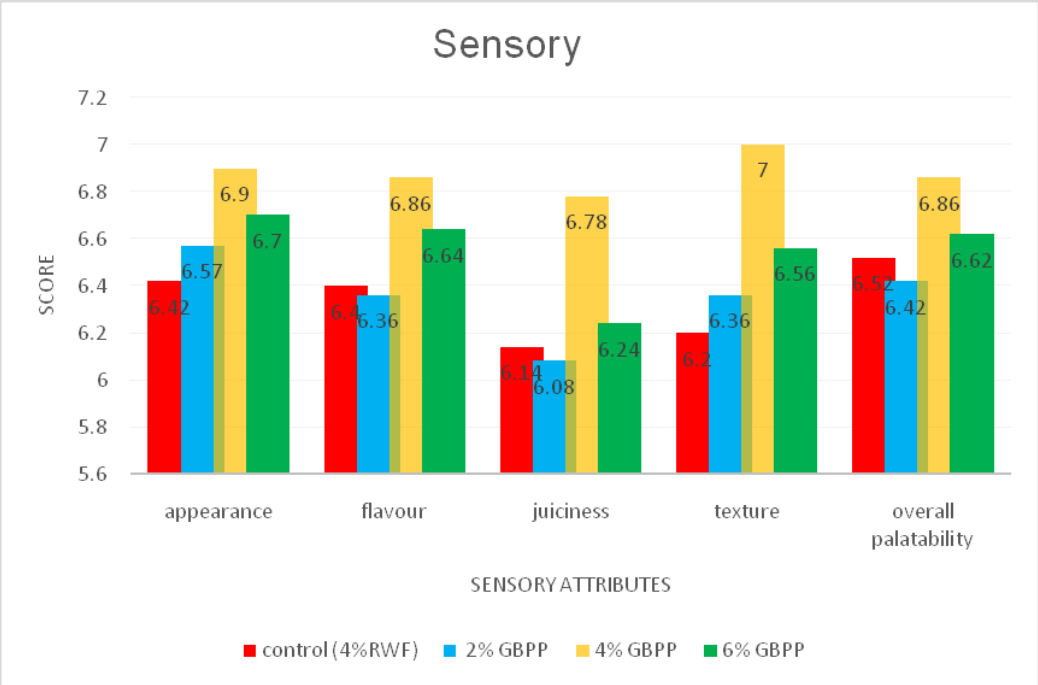


Fig. No. 4. 1 : Effect of green banana pulp powder on sensory attributes of chevon nuggets

Texture score of chevon nuggets incorporated with 4% GBPP (T2) (7.0) GBPP was highest and lowest for control (6.20). The texture scores were 6.36 and 6.56 for 2% GBPP (T1) and 6%GBPP (T3) added chevon nuggets, respectively. Result found to be significant. Decrease in texture score at addition of 6% GBPP (T3) may be due to textural changes in the product. Similar trend noted by Amina *et al*., (2014) for mutton nuggets incorporated with apple pomace.

Overall palatability scores of goat meat nuggets incorporated with 2% GBPP (T1), 4% GBPP (T2) and 6% GBPP (T3) were, 6.42, 6.86, 6.62. and for control 6.52 respectively. The score of overall palatability was highest for 4% GBPP (T2) added in chevon nuggets but differs non significantly. Non-significant results in overall palatability may be due to decrease goat meat and increase of GBPP in chevon nuggets by panellist.

All the scores were in acceptable range, but on sensory basis, the incorporation of GBPP up to 4% level were better than control & other treatments for all the sensory attributes and was considered as optimum for chevon nuggets

4.2. Proximate characteristic of chevon nuggets:

The data regards to proximate composition of all treatments and control presented in Table 4.2.1.and fig. 4.2,4.3

The moisture, protein, fat and ash show on-significant difference in all the treatments and control, increased level of the green banana pulp powder (GBPP) showed highest score of moisture in chevon nuggets were 6% GBPP (T3) 62.44and lowest of 2% GBPP (T1) 62.06. Similar findings were observed by Kumar *et al*. (2011) for chicken nuggets using green banana flour. Highest score of protein in chevon nuggets were 2%GBPP (T1) (15.05) and lowest of control (13.28). similar findings were observed by Kumar *et al*. (2011) for chicken nuggets using green banana flour. Highest level of fat in chevon nuggets (12.11) of 2% of GBPP (T1) and lowest score found in T3 (11.80) but T2 and T3 in result found to be non-significant ($p>0.05$). Similar findings were noted by Aamina *et al*. (2014) for mutton nuggets incorporated with apple pomace Ash content in chevon nuggets increases with increase in the level of green banana pulp powder.

Highest and lowest values was 3.32 and 3.24 of 6% GBPP (T3) and 2% (T1) GBPP respectively, findings of investigation are in close agreement with Kumar *et al.,* (2011) reported, increasing values of ash for chicken nuggets formulated with green banana and soybean hulls flours. A significant ($p<0.05$) increase in the fibre percentage was recorded with increase in the level of green banana pulp powder in chevon nuggets and control. The score for sensory evaluation that is overall acceptability i.e T2 and T3 are nearly same and non-significant and shown better acceptability. Hence selected for storage studies, similar trend of increase in fibre content with increase in level of incorporation of apple pomace in mutton nuggets was reported by Aamina.*et al*. (2014) and increased fibre content reported by kumar.*et al.,* (2011) for chicken nuggets formulated with green banana & soybean hulls flours.

4.3. pH, Emulsion stability and Cooking yield:

Table: 4.3.1 and fig.4.4. revealed that, the pH value indicates declining trend with addition of green banana pulp powder (GBPP). The pH value of control and treatments with different levels of incorporation of GBPP differs non significantly values decreased might be due to the mild sourness of green banana pulp powder (GBPP). Present findings are in agreement with observation of Kumar *et al*. (2011) for chicken nuggets formulated with green banana flours. Similarly, decreased pH value with addition of apple pomace in mutton nuggets found in Amina. *et al*., (2014).

The emulsion stability of chevon nuggets increased with incorporation of GBPP in treatments than control. The emulsion stability increased significantly in treatments and cooking yield improved significantly ($P<0.05$) within the treatments and control. The maximum value of emulsion stability was observed for control i.e., 88.09 and treatment 85.01,85.35,86.06 for 2%GBPP (T1), 4%GBPP (T2) and 6% GBPP (T3) respectively. Increase in the emulsion stability of goat meat nuggets with increase of GBPP it could be attributed due to increase of viscosity by the fibres which ultimately reduces shrinkage on cooking. similar findings recorded by Aamina *et al.*, (2014) for mutton nuggets incorporated with

4.2.1 Effect of addition of the green banana pulp powder on Proximate characteristic of chevon nuggets.

Level of GBPP	Moisture	Fibre	Protein	Fat	Ash
Control (4%RWF)	62.42±0.66	0.53±0.02^{a}	13.28±0.40^{a}	11.71±0.50	3.26±0.09
GBPP 2% (T1)	62.06±0.63	0.73±0.05^{b}	15.05±0.24^{b}	12.11±0.18	3.24±0.12
GBPP 4% (T2)	62.22±0.93	0.84±0.06^{ab}	14.18±0.42^{ab}	11.89±0.53	3.26±0.07
GBPP 6% (T3)	62.44±0.51	0.90±0.01^{c}	13.91±0.59^{ab}	11.80±0.28	3.32±0.13
P.value	**0.977**	**0.00**	**0.065**	**0.905**	**0.961**

Means with different superscripts differ significantly (P<0.05)

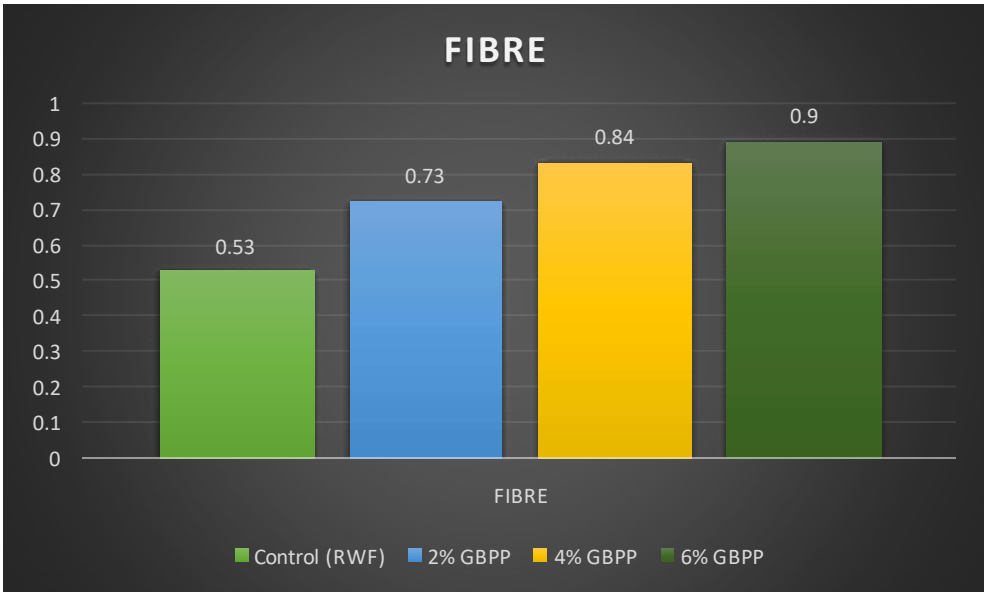


Fig. No.4. 2 : Fibre value of chevon nuggets incorporate with green banana pulp powder

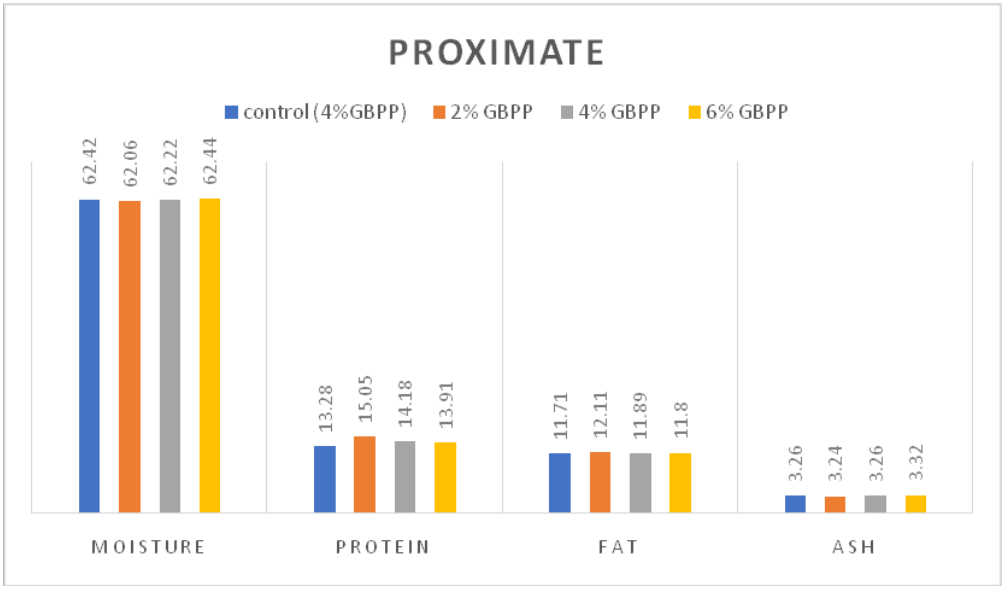
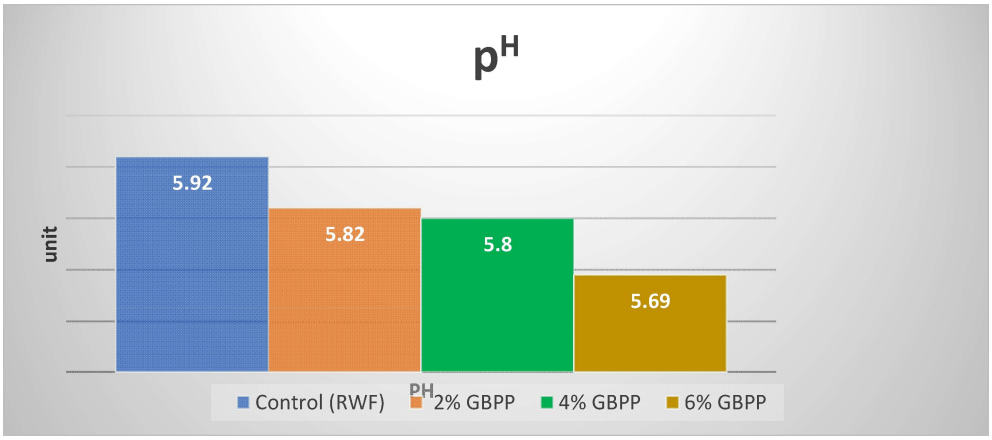


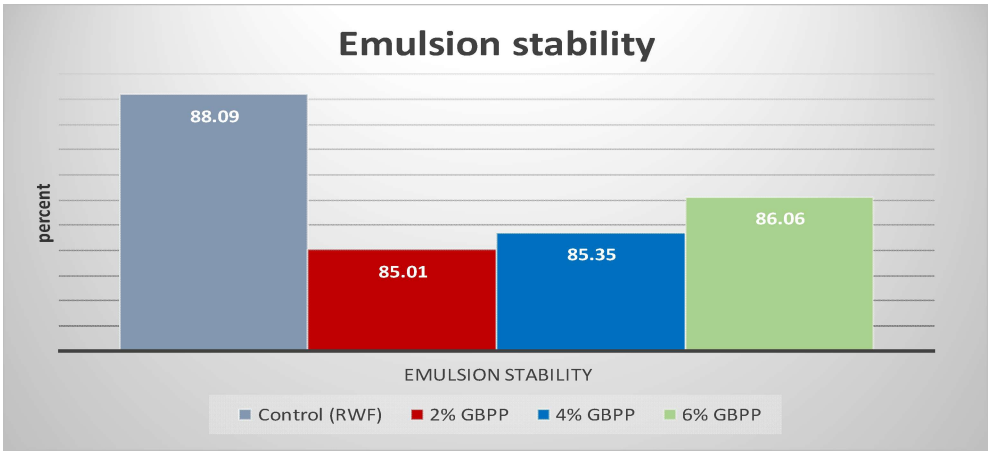
Fig. No.4.3: Effect of addition of the green banana pulp powder on Proximate characteristic of chevon nuggets.

4.3.1 Effect of addition of the green banana pulp powder on physico-chemical characteristic of chevon nugget

Level of GBPP	pH	Emulsion stability	Cooking yield
Control (4% RWF)	5.92±0.03	88.09±0.54^{b}	84.79±0.39^{a}
GBPP 2% (T1)	5.82±0.06	85.01±0.05^{a}	85.77±0.47^{a}
GBPP 4% (T2)	5.80±0.13	85.35±0.17^{a}	86.29±0.90^{ab}
GBPP 6% (T3)	5.69±0.08	86.06±0.84^{a}	87.78±0.39^{b}
P .value	**0.311**	**0.002**	**0.016**

Means with different superscripts differ significantly (P<0.05)





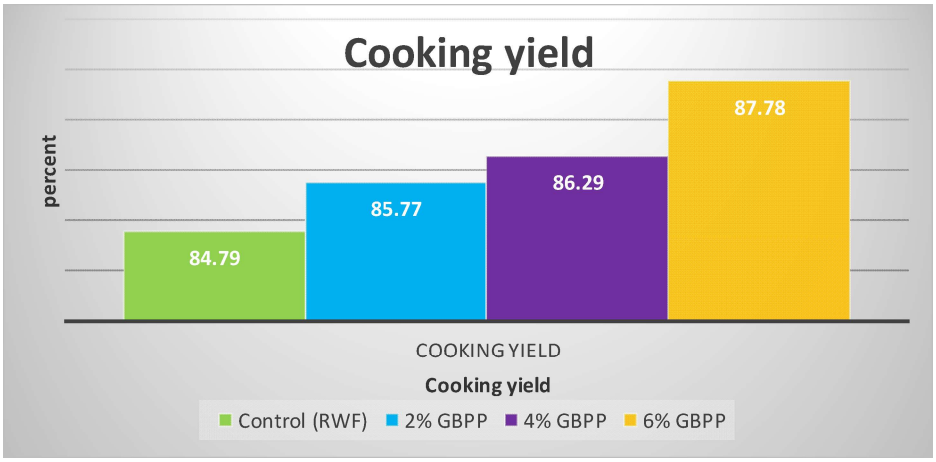


Fig. No.4. 4 : pH, Emulsion stability and cooking yield of chevon nuggets incorporated with different level of green banana pulp powder.

apple pomace. The present finding was similar with Kumar *et al.* (2011) for chicken nuggets formulated with green banana and soyabean hulls flours.

The Cooking yield of chevon meat nuggets increased significantly with addition of GBPP highest value of cooking yield was 87.78 of 6% GBPP (T3) and lowest 84.79 of control, lower values of cooking yield might be due to optimum absorption of moisture from the emulsion during cooking and also may be due to water binding capacity of the powder. similar, observation was noted by Kumar *et al*. (2011) for chicken nuggets formulated with green banana flours and soybean hulls flours.

4.4 Physico-chemical properties of chevon nuggets during refrigerated storage:

Selected level of green banana pulp powder was incorporated in preparation of chevon nuggets and stored under refrigeration temperature at 4 ± 1^{0}c. were evaluated for microbiological quality and sensory attributes at every 4 days interval till spoilage.

From the table 4.4.1 and fig.4.5,4.6,4.7. It is revealed the pH of chevon nuggets increased significantly throughout the storage period of 16 days. This increase in the pH might be due to accumulation of bacterial metabolites and break down of meat protein. Present findings were similar with those of Rindhe. (2009) for cooked chicken nuggets Similar trend reported by Jagtap *et al*., (2018) for chevon emulsion with carcia papaya and the results are congruent with the finding of Sakunde (2004) for chicken patties using various binder., TBA value of chevon nuggets was estimated by the extraction method of Strange *et al*. (1977) in present study TBA values of both control and treatment treated chevon nuggets differ significantly ($p<0.05$) throughout the storage period indicating lipid oxidation and production of volatile metabolites, initial TBA values for control and GBPP treated chevon nuggets were 0.26 and 0.20 mg MDA/kg and increased up to 1.03 and 0.97 for control and GBPP (treatment) treated nuggets on 16^{th} day of storage which were good within threshold limit of 1-2 MDA/kg of meat. Relatively lower values in treated products than control might be due to antioxidant property in GBPP, Talukdar *et al.* (2015). Similar observation reported by Shinde *et al*., (2019) for Japanese quail meat nuggets using finger

millet flour, Same increasing trend was reported in tyrosine values during entire refrigeration storage of chevon nuggets.

4.5. Microbiological quality:

Storage related changes in microbiological quality of chevon meat nuggets with total plate count, psychrophilic count, coli form count during refrigerated storage are presented in table 4.5.1., fig. 4.8,4.9. and plate 4.1,4.2,4.3,4.4,4.5,4.6.

It was revealed that total plate count increased significantly($P<0.05$) in control and all treatments with the progressive storage at refrigerated temperature there was increase of total plate count on 16^{th} day of storage. Total plate count in 4% GBPP (T2) added chevon nuggets showed relatively lower than the control (4% RWF) throughout the storage which is indicative of presence of polyphenols in GBPP that posse's antimicrobial activity. Singh and Raghuvanshi (2012), Kumar *et al*. (2011) and Jagtap S. (2018) psychrophilic count was not detected on 0 day but detected on 4^{th} day onwards increasing pattern was observed during storage of nuggets till spoilage i.e 16^{th} day of storage. Similar observation found in Kumar *et al.* (2011) for quality and storability of chicken nuggets formulated with green banana and soybean hulls flours.

Coliform count was not detected in storage period of '0' days. It may be attributed due to higher temperature of cooking, hygienic handling and processing of the product.

4.6 Sensory attributes of chevon nuggets during storage period:

The average score for sensory attributes of chevon nuggets during refrigerated storage (4±1℃) are presented in table 4.6.1 and fig 4.10.

The sensory result from table 4.6.1 revealed that score for appearance, colour ,texture and juiciness among the treatment differs non-significantly up to 4^{th} day and later on differ significantly from 4^{th} day of storage till spoilage during storage,

Table 4.4.1. Storage related change in physico-chemical characteristic of chevon nuggets during refrigerated storage (4±1°C).

Type of product	Storage period (days)					Treatment means
	0	**4**	**8**	**12**	**16**	
	PH					
Control	6..12±0.06	6.22±0.04	6.26±0.02	6.42±0.04	6.58±0.04	**6.32[a]**
GBPP (4%)	5.90±0.04	6.10±0.03	6.24±0.09	6.32±0.02	6.48±0.06	**6.20[b]**
Storage period mean	**6.01[a]**	**6.16[b]**	**6.25[c]**	**6.37[d]**	**6.53[e]**	
	TBA value (mg MDA/kg)					
Control	0.26±0.04	0.45±0.04	0.64±0.04	0.87±0.03	1.03±0.04	**0.65[a]**
GBPP (4%)	0.20±0.02	0.40±0.02	0.60±0.03	0.84±0.03	0.97±0.03	**0.60[b]**
Storage period mean	**0.23[a]**	**0.42[b]**	**0.62[c]**	**0.85[d]**	**1.00[e]**	
	TYROSINE value (mg/100 gm)					
Control	15.75±0.23	17.80±0.38	18.50±0.03	19.90±0.31	20.80±0.08	**18.55[a]**
GBPP (4%)	14.95±0.20	15.50±0.19	16.70±0.01	17.95±0.17	19.55±0.16	**16.93[b]**
Storage period mean	**15.35[a]**	**16.65[b]**	**17.60[c]**	**18.92[d]**	**20.17[e]**	

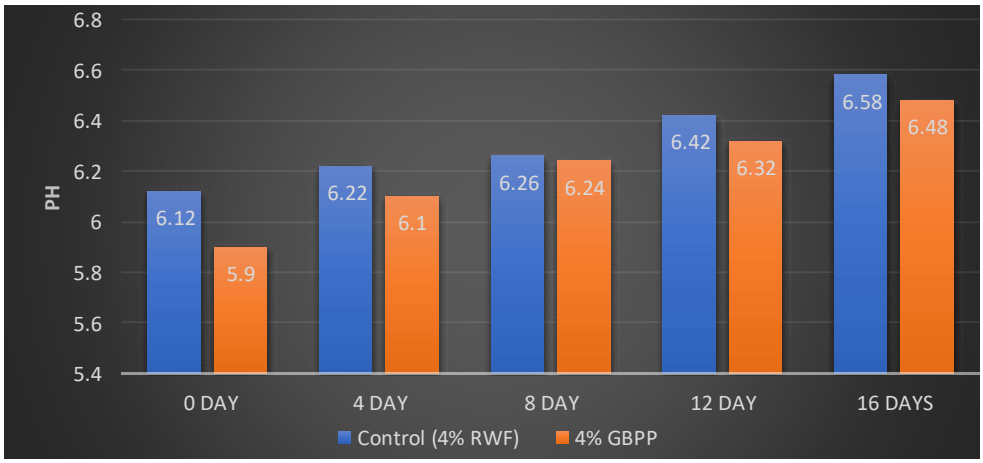


Fig. No.4. 5 : Storage related change in pH of chevon nuggets during refrigerated storage (4±1^{0}C).

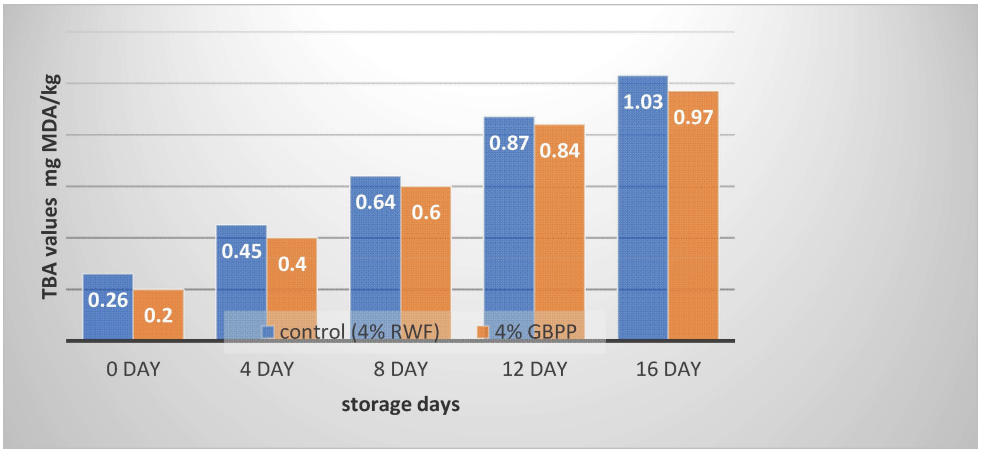


Fig. No.4. 6 : Storage related change in TBA values of chevon nuggets during refrigerated storage (4±1^{0}C).

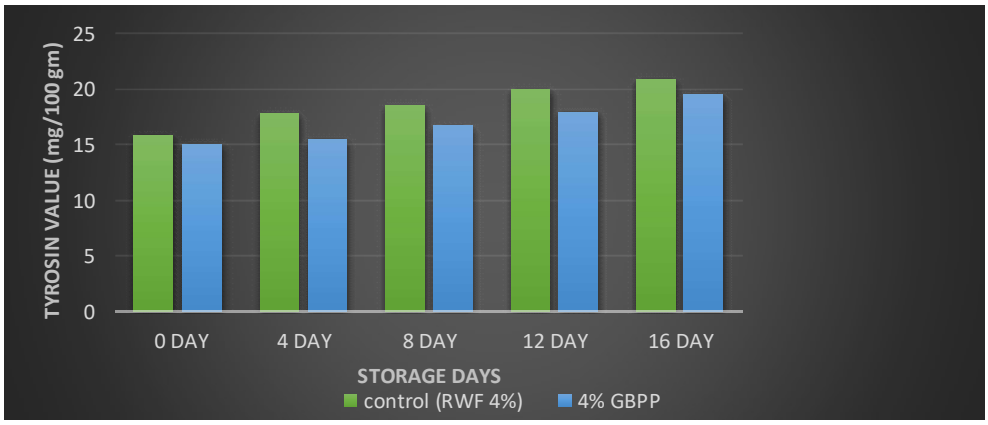


Fig. No.4. 7 : Storage related change in tyrosine values of chevon nuggets during refrigerated storage (4±1^{0}C).

4.5.1. Storage related changes in microbiological quality of chevon nuggets during refrigerated storage (4 ± 1ºC).

Type of Product	Storage period days					Treatment means
	0	4	8	12	16	
	Total plate count (log cfu/g)					
Control	4.40±0.03	5.53±0.02	5.67±0.08	5.87±0.08	6.27±0.05	**5.55^{a}**
GBPP 4% (T2)	4.26±0.06	5.37±0.08	5.65±0.09	5.80±0.09	6.13±0.05	**5.44^{b}**
Storage Period Mean	**4.33^{a}**	**5.45^{b}**	**5.66^{c}**	**5.83^{d}**	**6.2^{e}**	
	Total psychrophilic count (log cfu/g)					
Control	ND	4.75±0.06	5.70±0.06	6.11±0.06	6.39±0.14	**5.73^{a}**
GBPP 4% (T2)	ND	4.61±0.14	5.49±0.10	5.98±0.06	6.14±0.19	**5.55^{b}**
Storage Period Mean	**ND**	**4.68^{a}**	**5.59^{b}**	**6.04^{c}**	**6.26^{d}**	
	Total coliform count (log cfu/g)					
Control	**ND**	**ND**	**ND**	**ND**	**ND**	**-**
GBPP 4%	**ND**	**ND**	**ND**	**ND**	**ND**	**-**
Storage Period Mean	**ND**	**ND**	**ND**	**ND**	**ND**	**-**

ND-Not detected

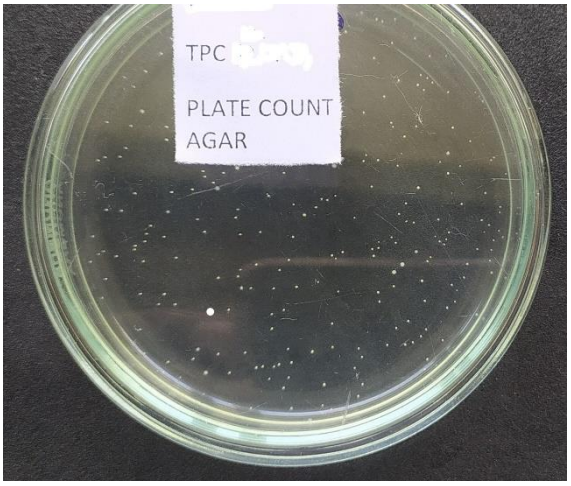


plate 4.1:Control -Total plate count (16 day)

plate 4.2 : Treatment- Total plate count (16 day)

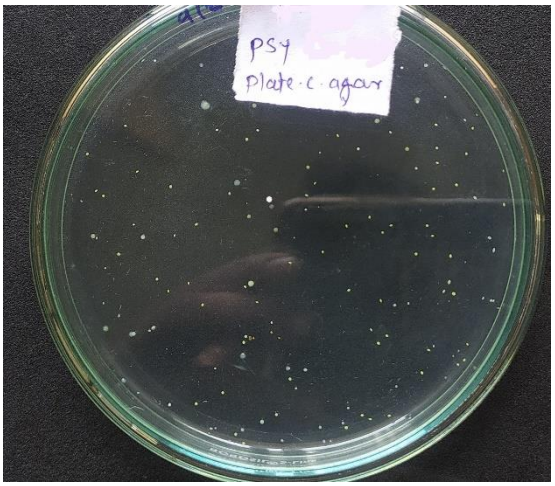


plate 4.3 :Control -Total psychrophilic count (16 day)

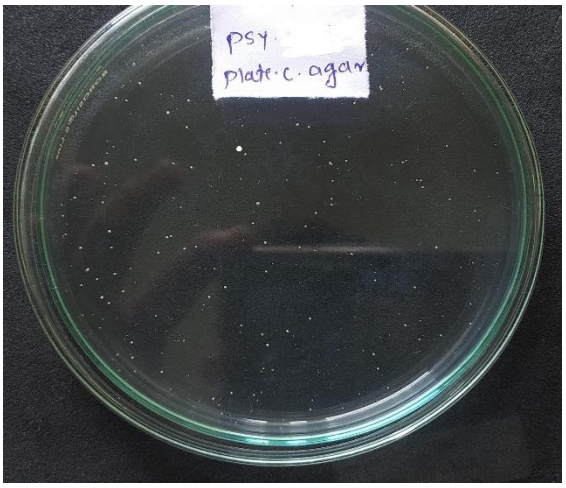


plate 4.4 : Treatment- Total psychrophilic count (16 day)

plate 4.5 : Control-Total Coliform count (16 days)

plate 4.6: Treatment-Total coliform count (16 days)

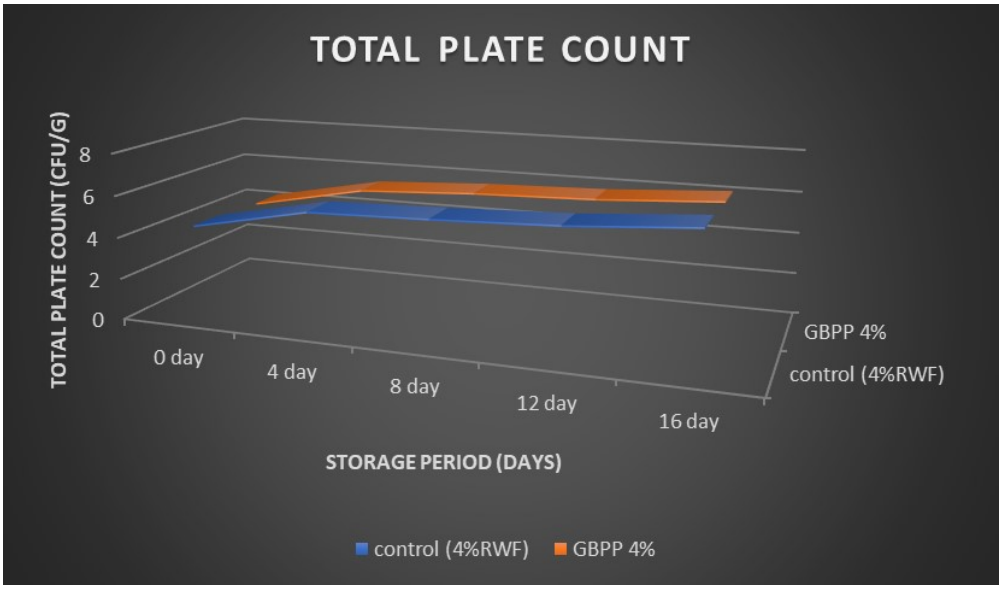


Fig. No. 4.8: Storage related changes in total plate count of chevon nuggets during refrigerated storage (4±1)°C

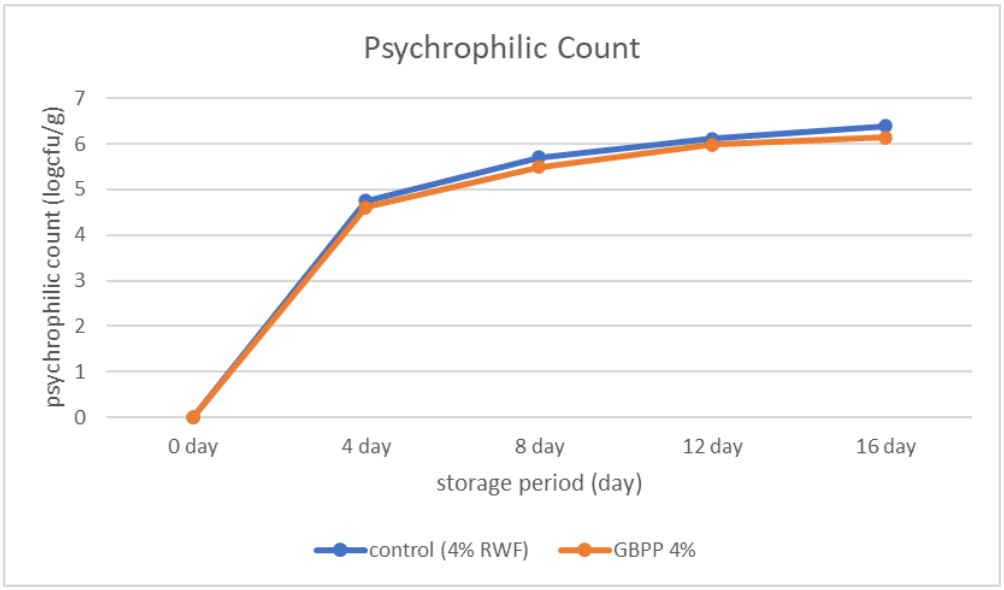


Fig. No. 4. 9 : Storage related changes in psychrophilic count of chevon nuggets during refrigerated storage.

4.6.1. Storage related changes in sensory attributes of chevon nuggets during refrigerated storage (4 ± 1ºC)

Type of products	Storage period (days)					Treatment means
	0	4	8	12	16	
	Appearance					
Control	6.92±0.04	6.82±0.16	6.58±0.04	6.02±0.04	5.16±0.08	**6.3^{b}**
4% GBPP (T2)	7.14±0.1	7.14±0.19	6.6±0.1	6.16±0.02	5.52±0.02	**6.51^{a}**
Storage period mean	**7.03^{a}**	**6.98^{a}**	**6.59^{b}**	**6.09^{c}**	**5.34^{d}**	
	Flavour					
Control	7.14±0.05	6.88±0.05	6.74±0.02	6.10±0.18	5.66±0.10	**6.50^{b}**
4% GBPP (T2)	7.26±0.08	7.12±0.06	6.86±0.07	6.38±0.1	6.00±0.05	**6.72^{a}**
Storage period mean	**7.20^{a}**	**7.00^{b}**	**6.80^{c}**	**6.24^{d}**	**5.83^{e}**	
	Juiciness					
Control	6.72±0.09	6.58±0.12	6.30±0.18	6.06±0.20	5.58±0.09	**6.25^{b}**
4% GBPP (T2)	6.98±0.10	6.82±0.16	6.40±0.09	6.36±0.07	6.04±0.05	**6.52^{a}**
Storage period mean	**6.85^{a}**	**6.7^{a}**	**6.35^{b}**	**6.21^{b}**	**5.81^{c}**	
	Texture					
Control	6.98±0.05	6.88±0.04	6.58±0.04	6.24±0.08	5.46±0.05	**6.43^{b}**
4% GBPP (T2)	7.16±0.05	7.00±0.03	6.66±0.05	6.36±0.12	5.62±0.15	**6.56^{a}**
Storage period mean	**7.07^{a}**	**6.94^{a}**	**6.62^{b}**	**6.30^{c}**	**5.54^{d}**	
	Overall palatability					
Control	6.86±0.04	6.62±0.06	6.44±0.07	5.84±0.15	5.38±0.10	**6.23^{b}**
4% GBPP (T2)	7.04±0.05	6.86±0.05	6.82±0.04	6.10±0.04	5.88±0.07	**6.54^{a}**
Storage period mean	**6.95^{a}**	**6.74^{b}**	**6.63^{b}**	**5.97^{c}**	**5.63^{d}**	

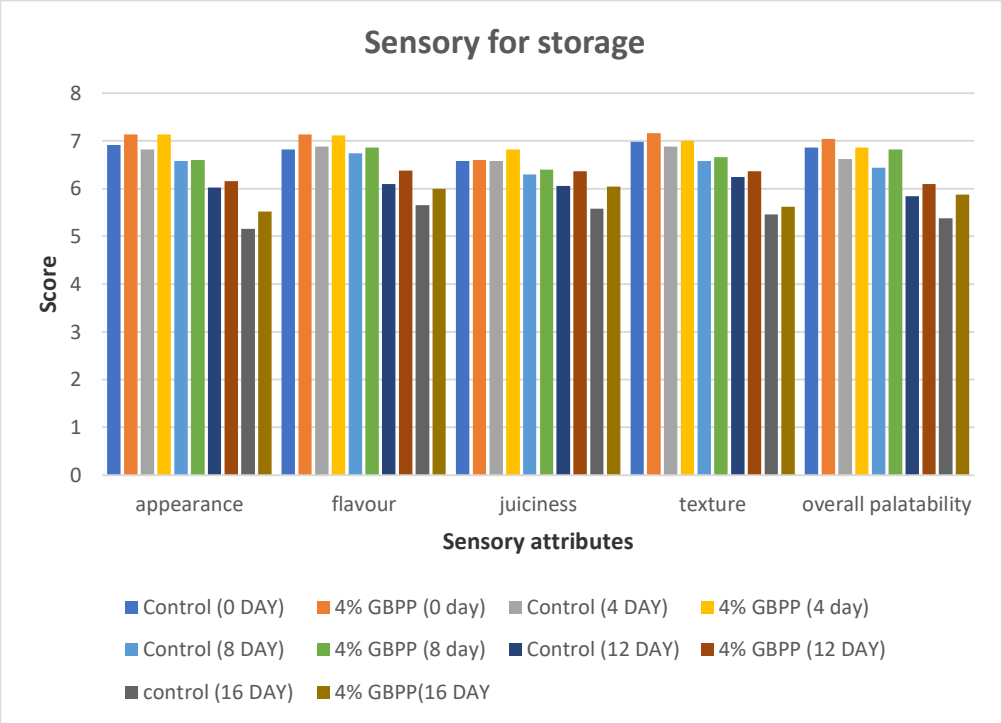
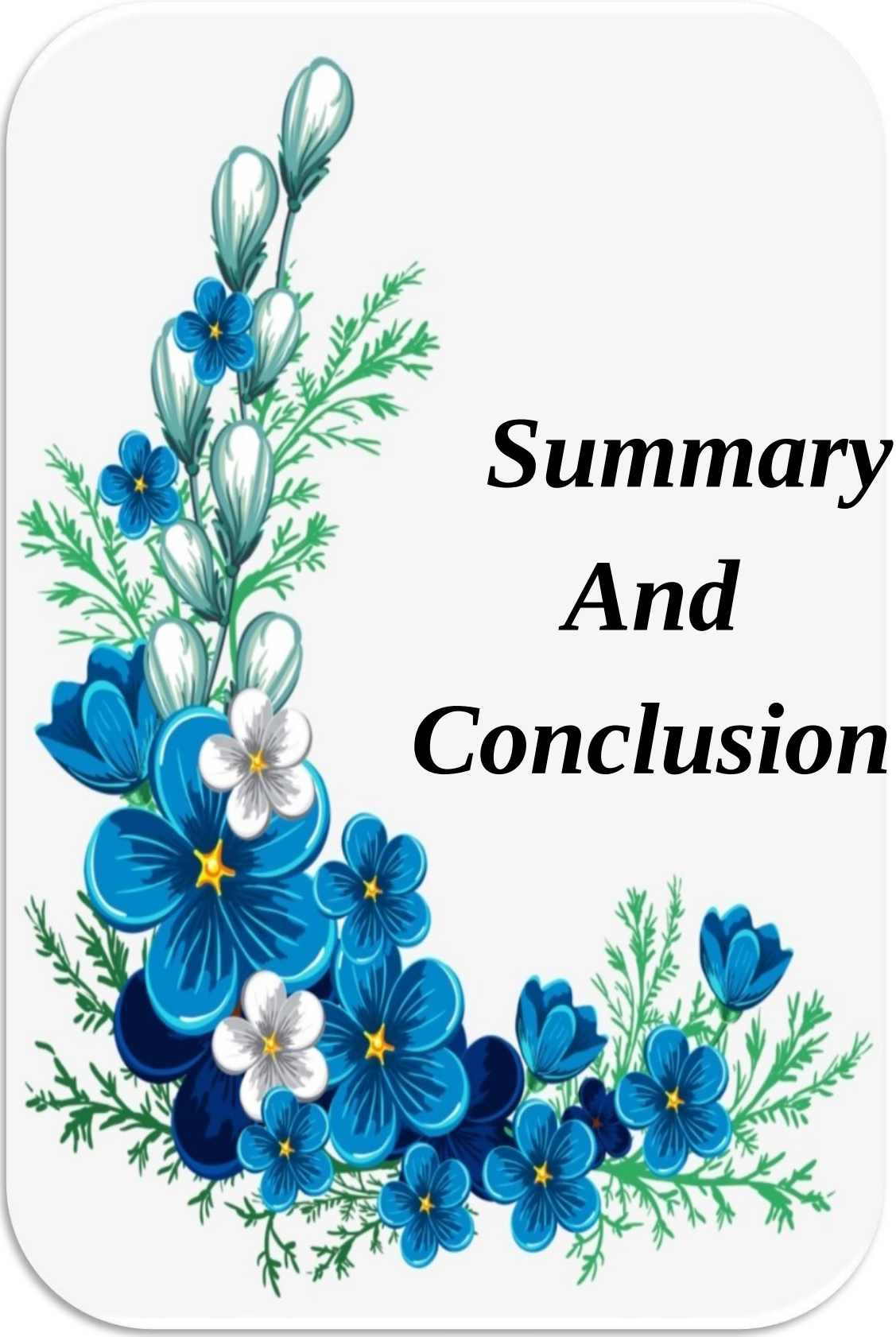


Fig. No. 4. 10 : Storage related changes in sensory attributes of chevon nuggets during refrigerated storage (4 ± 1°C)

The present finding was in consonance with Kumar *et al.,* (2011) who reported significant declining trend for colour and appearance for quality and storability of chicken nuggets, the reduction in juiciness scores might be due to loss of moisture from the product during the storage Similar observation found in Shinde *et al*., (2019) for Japanese quail meat nuggets using finger millet flour during refrigerated storage. The texture score was influenced significantly throughout the storage period. decrease in textural score might be due to release of moisture and depletion of fat during storage. Kumar *et al*., (2011) for chicken nuggets formulated with green banana and soybean hulls flours and similar finding reported by Verma *et al.,* (2013) for guava powder as an antioxidant dietary fibre in sheep meat nuggets.

Flavour scores declined significantly ($p<0.05$) towards the end of storage, the decline in flavour score might be due to increase lipid oxidation resulting in malonaldehyde formation, liberation of free fatty acids and increased microbial growth Gadekar *et al.,* (2009). Similar findings are observed in Aamina *et al*., (2014) for sensory and textural properties of mutton nuggets. Declining trend was also noted for overall palatability of goat meat nuggets during storage. The palatability score was decrease significantly($p<0.05$) during entire storage period. The scores for overall palatability

Those based on the observation of sensory attributes and storage study it is concluded that chevon nuggets incorporated with 4% GBPP were acceptable up to 16 days of refrigerated storage.



Summary And Conclusion

CHAPTER - V

SUMMARY AND CONCLUSIONS

The demand for processed and value-added meat products is increasing with increase in consumers view towards fibre rich food, nutrition and quality of meat products. however, the demand for goat meat (chevon) is ever increase worldwide because of its high-quality. It contains quality protein, taste property enhancing fat, energy providing carbohydrates, essential amino acids and micronutrients viz, iron, zinc, copper, sodium, potassium, Magnesium and phosphorus and vitamin B complex specially vit B_1, vit B_2, niacin, pyridoxine and cobalamin that create it a diet and prevention from Anaemia, obesity, keep bone strong and increase immunity.

To meet changed life style requirements of present generation and increase demand of fibre rich food products. Processing aids in development of variety of value-added suitable meat products thus, planned to develop chevon meat nuggets incorporated with green banana pulp powder (GBPP).

Raw goat meat will be procured from authorized retail meat shop in Udgir town within 1-2 hrs of slaughter, packed in pre sterilized low-density polyethylene (LDPE) bags and brought to the laboratory, kept in refrigerator at 4 ± 1^0C for 4-6 hours and then manually bone, tendon, and separable connective tissues were trimmed off. Thereafter, meat kept under frozen condition at -18^0C.in deep freezer till further use. The bone less meat ground twice in meat mincer with 6 mm plate. After mincing, Emulsion of each formulation was prepared using bowl chopper The prepared emulsion was tightly packed in oil coated metallic nugget box fitted with lid and steam cooked for 30 min. The cooked mould was cooled at room temperature, the loves were cut into nuggets which were packed in (LDPE) pouches and subsequently analysed as per the experimental requirement. Selected product was judged on the basis of sensory quality and physico-chemical characteristics.

5.1 Quality appraisal of chevon nuggets made with green banana pulp powder

The meat emulsion for control product consisted of basic formulation with 4% refined wheat flour, Chevon nuggets were prepared with addition of different level of green banana pulp powder (2%,4% and 6%). The initial trials were conducted to assess the best level of incorporation of GBPP into chevon nuggets. On the basis of sensory evaluation by trained sensory panel the result reviled that the score for 4% GBPP recorded significantly higher scores for all the sensory attributes viz. appearance, flavour, juiciness and texture score increased significantly and non-significant for overall palatability the chevon nuggets containing 4% GBPP were selected for further study. incorporation of GBPP in chevon nuggets formulation cause slight increase in emulsion stability, cooking yield whereas slight decrease in pH. however, statistically moisture, protein, fat and ash in nuggets were non-significant and fibre increased significantly.

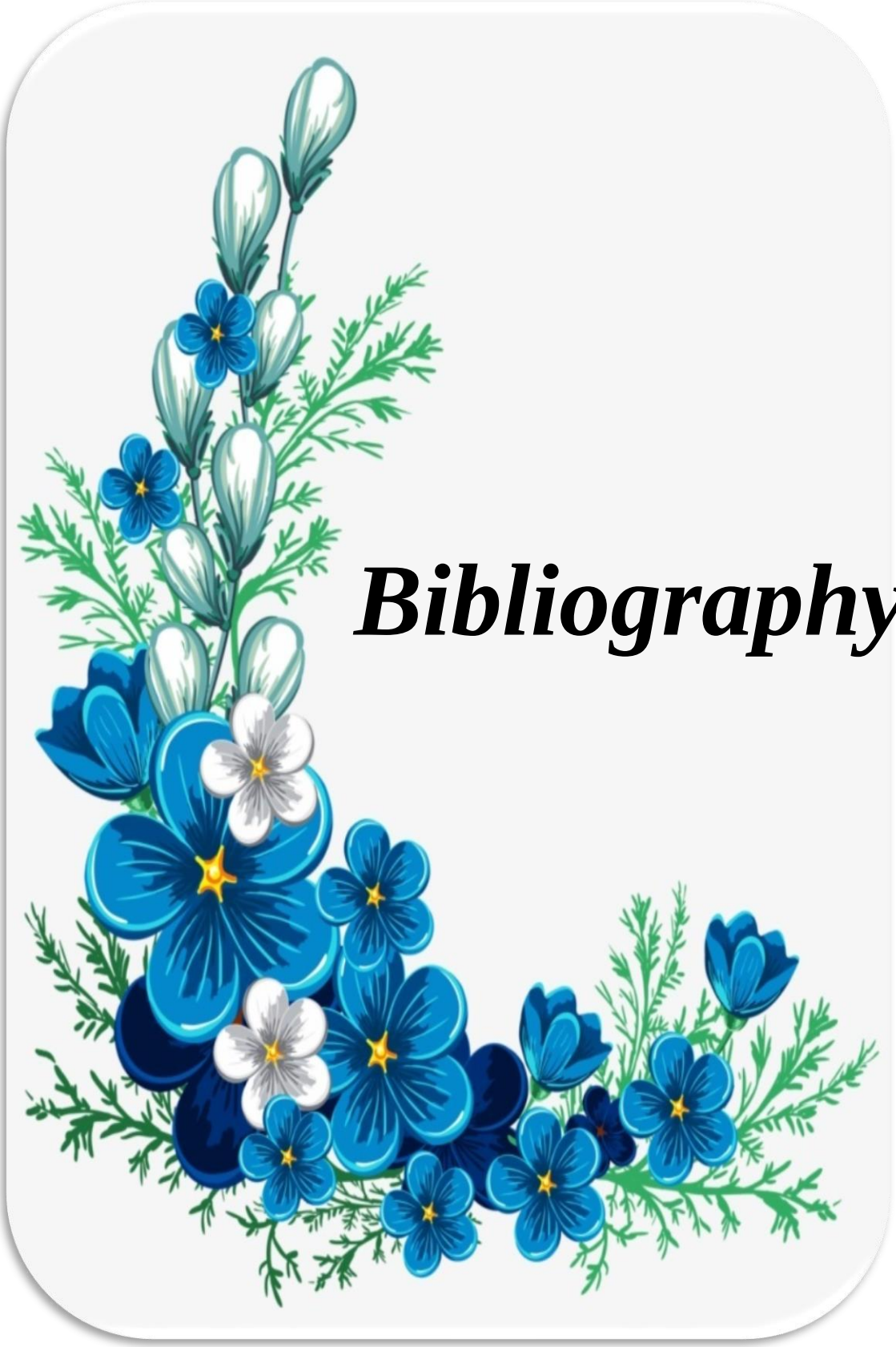
Based on the findings of fibre, sensory quality and physico-chemical characteristics of chevon nuggets incorporated with 4% level of green banana pulp powder (GBPP) was selected for further storage studies.

5.2 Shelf life of chevon nuggets during refrigerated storage (4±1 ℃).

The shelf life of selected chevon nuggets made with incorporation with 4% GBPP was assessed at refrigeration temperature (4±1℃). During refrigerated storage of 16 days pH, TBA number and tyrosine values of chevon nuggets increased significantly ($p<0.05$) throughout storage period. where the sensory score of all attributes declined significantly. whereas, total psychrophilic counts and total coliform count was not detected in both control and treatment for 0 days but from 4 days total psychrophilic count was increased significantly ($P<0.05$) throughout the storage period but were within the spoilage limit indicating that the product could be safely stored for 16 days without adversely affecting the quality of the chevon nuggets.

CONCLUSION

1. Chevon nuggets made with incorporation of 4% GBPP powder ranked superior over other combination with regard to sensory quality as well as physicochemical characteristics.
2. The sensory quality in the optimized nuggets increase in emulsion stability and cooking yield and fibre content significantly.
3. Chevon nuggets made with 4% GBPP powder when packed aerobically in HDPE pouches were acceptable up to 16 days at refrigerated temperature ($4+1^0$C).



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Vitae

VITAE

Mr. Shaikh Sultan Fazlur Rheman, the author of this research work was born on dated 17th July Nineteen Ninety-Two in Nanded Dist. of Maharashtra.

He has completed his matriculation from Sadhana High School, Degloor and got First Division with Distinction and Second Class in Higher School Certificate from Degloor College, Degloor.

Thereafter, he joined College of Veterinary and Animal Sciences, Parbhani in the year 2012 and obtained B.V. Sc & AH in 2018 in Second Division.

During Graduation studies, he was actively engaged in Clinical rotation, Animal Health Camp, vaccination programs and he has participated in National Service Scheme and participated in various social activities.

For post-graduation studies he joined, College of Veterinary and Animal Sciences, Udgir in 2018 in the discipline of Livestock Products Technology.

Thesis Abstract

THESIS ABSTRACT

a) Title of the thesis (in Capital letters)	: PROCESS STANDARDIZATION OF FIBRE RICH CHEVON NUGGETS INCORPORATED WITH GREEN BANANA PULP POWDER
b) Full name of student	: Shaikh Sultan Fazlur Rheman
c) Name and address of Major Advisor	: Dr. A.A. Devangare Associate Professor, Dept. of livestock products technology, COVAS, Udgir.
d) Degree to be awarded	: M.V. Sc
e) Year of award of degree	: 2021
f) Major subject	: livestock products technology
g) Total number of pages in the thesis	: 53
h) Number of words in the abstract	: 277
i) Signature of Student	:
j) Signature, Name and address of	Dr. A.A. Devangare Associate Professor, Dept. of livestock products technology, COVAS, Udgir.

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ABSTRACT

The present study was aimed to develop chevon nuggets with incorporation of different level of green banana pulp powder (GBPP) 2%,4% and 6%. Raw goat meat was procured and kept in refrigerator at 4 ± 1^{0}C. After deboning, removal of subcutaneous fat, tendon and separable connective tissue were trimmed off from

chevon, packed in LDPE and stored overnight at -18 ℃ in deep freezer till further use. The results obtained in present study indicates that, there was significant increase in emulsion stability and cooking yield with increase in the level of addition of GBPP in chevon nuggets The moisture and ash increased, protein and fat declined non significantly but fibre increases significantly with addition of GBPP at different level. Incorporation of 4% GBPP exhibited significantly higher sensory scores except overall palatability than other treatments and control During storage at refrigeration temperature (4±1℃). The pH, TBA and tyrosine increased with the raise in storage period. Likewise, total plate count (TPC) increased significantly from 0 days till spoilage. Psychrophilic counts and Coliform count were not detected on 0 days of storage in treatment as well as control but psychrophiles were detectable on 4^{th} day of storage in all treatments and control, this may be due to destruction of psychrophiles during cooking. psychrophilic counts significantly increased from 4^{th} day till spoilage, Sensory score declined significantly as storage period advances up to 16^{th}days.

Based on the above findings, it is concluded that a value added, nutritionally balanced fibre rich chevon nuggets could made with incorporation of 4% GBPP without adversely affecting its quality and were acceptable for a period of 16^{th} days when packed in LDPE bags and stored at refrigeration temperature (4±1℃)

प्रबंध

सारांश

प्रबंध सारांश

अ) प्रबंधाचे शिर्षक : हिरव्या केळीच्या लगदा पावडरसह एकत्रित फायबर-समृद्ध शेळीच्या मांसापासून तयार केलेल्या नगेट्सचे प्रक्रिया प्रमाणिकरण.

ब) विद्यार्थ्यांचे नाव : शेख सुलतान फझलुर रहेमान

क) मार्गदर्शक : डॉ. अ.अ. देवांगरे
सहयोगी प्राध्यापक
पशुजन्य पदार्थ प्रक्रिया तंत्रज्ञान
पशुवैद्यक व पशुविज्ञान महाविद्यालय,उदगीर.

ड) वर्ष : २०२१

इ) पदवी : एम.व्ही.एस.सी.

फ) मुख्य विषय : पशुजन्य पदार्थ प्रक्रिया तंत्रज्ञान

ग) प्रबंधाचे एकूण पाने : ५३

ह) सारांशातील एकूण शब्द : २६४

ई) विद्यार्थ्यांची स्वाक्षरी :

ज) विभाग प्रमुखाची स्वाक्षरी : डॉ. अ.अ.देवांगारे
सहयोगी प्राध्यापक,
पशुजन्य पदार्थ प्रक्रिया तंत्रज्ञान,
पशुवैद्यक व पशुविज्ञान महाविद्यालय,उदगीर.

सारांश

प्रस्तुत संशोधनात हिरव्या केळीच्या लगद्याची पावडर (जीबीपीपी) २%, ४%, ६% अश्या प्रमाणात त्यांच्या समावेशाने चेवोन नग्गेट्स बनवण्याचे लक्ष्य होते. बकरीचे मांस खरेदी केले गेले आणि शीतकपाटात (४±१)0 से. वर ठेवले गेले. त्वचेखालील चरबी, स्नायूबंध आणि विभागलेल्या संयोजी उती चेव्हॉनपासून

वेगळ्या केल्या गेल्या,व त्या एलडीपीई वेष्टनबद्ध करून पुढील वापर होईपर्यंत अतिशीतकपाटात -१८ 0 से. या तापमानाला रात्रभर ठेवल्या. सध्याच्या अभ्यासामध्ये प्राप्त झालेल्या परिणामांवरून असे दिसून येते की जीबीपीपीच्या वेगवेगळ्या स्तरावर चेव्हन नगेट्स मध्ये जीबीपीपीच्या वाढीसह, पायस स्थिरतेत आणि शिजवन क्षमतेमध्ये लक्षणीय वाढ झाली, ओलावा आणि राख वाढली, प्रथिने आणि चरबीमध्ये लक्षणीय घट झाली परंतु तंतुमय पदार्थांमध्ये लक्षणीय वाढ झाली. ४% जीबीपीपीच्या समावेशकतेमध्ये एकंदरीत स्वादिष्टता वगळून इतर संवेदन चाचण्या हया उपचार गट व नियंत्रित गट हयांच्या पेक्षा शीत-तापमानाला (४±१) 0 से साठवून ठेवल्यावर लक्षणीयरित्या वाढलेल्या आढळल्या. साठवण काळाच्या वाढी सह सामू, टीबीए आणि टायरोसीन मूल्य सुद्धा वाढले. त्याच प्रमाणे एकूण प्लेट गणना (टीपीसी), ० दिवसापासून ते खराबी पर्यंत लक्षणीयरित्या वाढली. साठवण काळाच्या ० व्या दिवशी शीतवाढ जिवाणू गणना व कोलाय गणना हि उपचार व नियंत्रण गटामध्ये शोधण्यायोग्य नव्हती, परंतु साठवण काळाच्या ४ थ्या दिवशी उपचार व नियंत्रण गटामध्ये शीतवाढ जिवाणू हे शोधण्यायोग्य होते, यामागे शीत वाढ जिवाणूंचा शिजवन्यादरम्यान झालेला नाश असू शकतो. शीतवाढ जिवाणूची संख्या हि ४ थ्या दिवसापासून नाश होईपर्यंत हि लक्षणीयरीत्या वाढली, संवेदनात्मक चाचणी गुण हे १६ व्या दिवसापर्यंत जसजशी साठवण क्षमता वाढवली तसतसे लक्षणीयरीत्या कमी झाले. वरील अभ्यासातील निरीक्षणांवरून असा निष्कर्ष काढता येतो कि, मूल्यवर्धित, पौष्टीकरित्या संतुलित तंतुमय पदार्थमय चेवोन नुग्गेट्स हे जर एलडीपीई च्या वेष्टनात सुमारे (४ ± १) 0 से या तापमानात साठवून ठेवले तर ४% जीबीपीपीच्या समावेशकतेने कोणत्याही प्रतिकूल परिणामांशिवाय व त्याचे मूल्य ढासळू न देता १६ दिवसांपर्यंत स्वीकारहार्य आहेत.


Appendix

ANNEXURE I

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY, COVAS, UDGIR

PROFORMA FOR ORGANOLEPTIC EVALUATION OF MEAT PRODUCTS

Name : Date : / /2021

Product :

Scoring Guide :

Sensory attributes	8-point scale for descriptive attributes of product							
	8	7	6	5	4	3	2	1
Appearance Flavour Juiciness Texture Overall palatability	Excellent Extr.desirable Extr.juicy Extr.desirable Extr.palatable	V.good V.desirabl V.juicy V.desirable V.palatable	Good Mod.desirabl Mod.juicyMod.desirable Mod.palatable	fair Sli.desirabl Sli.juicy Sli.desirable Sli.palatable	Sli.poor Sli.undesirabl Sli.dry Sli.undesirable Sli.unpalatable	Mod.poor Mod.undesirabl Mod.dry Mod.undesirable Mod.unpalatable	V.poor V.undesirabl V.dry V.undesirable V.unpalatable	Extr.poor Extr.undesirabl Extr.dry Extr.undesirable Extr.unpalatable
Sample 1 2 3 4	Appearance		flavour	juiciness		texture	overall palatability	

Remarks Signature