

**QUALITY CHARACTERISTICS OF CHICKEN BITES ENRICHED
WITH WHEAT FLOUR**

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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2024

DECLARATION OF STUDENT

I hereby declare that the experimental research work and interpretation of the thesis entitled **“QUALITY CHARACTERISTICS OF CHICKEN BITES ENRICHED WITH WHEAT FLOUR”** 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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Mr. **AHER SHIVAJI DATTRAO** has satisfactorily prosecuted his course of research for a period of not less than one semester and that the thesis entitled **“QUALITY CHARACTERISTICS OF CHICKEN BITES ENRICHED WITH WHEAT FLOUR”** submitted by him is the result of original research work and is of sufficiently high standards to warrant its presentation to the examination in the subject of **LIVESTOCK PRODUCTS 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 for a degree of any other University.

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This is to certify that the thesis entitled **“QUALITY CHARACTERISTICS OF CHICKEN BITES ENRICHED WITH WHEAT FLOUR”** submitted by **Mr. AHER SHIVAJI DATTRAO** to the Maharashtra Animal and Fishery Sciences University in partial fulfillment of the requirement for the degree of **MASTER OF VETERINARY SCIENCE** in the subject of **LIVESTOCK PRODUCTS TECHNOLOGY** has been approved by the Student’s Advisory Committee after oral examination in collaboration with the External Examiner.

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Date:

Place: Parbhani

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LIST OF ABBREVIATIONS

°C	:	Degree Celsius
%	:	Percent
AOAC	:	Association of Analytical Chemists
APHA	:	American Public Health Association
et al	:	et alia (and other people)
APEDA	:	Agricultural and Processed Food Products Export Development Authority
BAHS	:	Basic Animal Husbandry Statistics
Fig	:	Figure
MT	:	Million Tonnes
DAHD	:	Department of Animal Husbandry and Dairying
g	:	Gram
g/ml	:	Gram/Milliliter
Kg	:	Kilogram
HCL	:	Hydrochloric acid
Log 10	:	Logarithm of x to the base 10
hr	:	Hour
LDPE	:	Low density polyethylene
ml	:	Milliliter
min	:	Minutes
mg	:	Milligram
Nm	:	Nanometer
ND	:	Non detected
OD	:	Optical Density
<	:	Less Than
i.e.	:	That is
>	:	More
pH	:	Negative logarithm of hydrogen ion
USDA	:	United State Department of Agriculture
NaOH	:	Sodium Hydroxide

TBA	:	Thiobarbituric Acid
TE	:	Tellurium
TBARS	:	Thiobarbituric Acid Reacting Substances
TCA	:	Trichloroacetic acid
TPC	:	Total plate count
WF	:	25% Whole wheat Flour
C	:	100% whole wheat flour
WF15	:	15% whole wheat flour and 85% chicken meat
WF25	:	25% whole wheat flour and 75% chicken meat
WF35	:	35% whole wheat flour and 65% chicken meat
Wt.	:	Weight
Rs.	:	Rupes



Introduction



CHAPTER - I

INTRODUCTION

The poultry sector continues to grow and industrialize in many parts of the world, which contributes to the national GDP as well as provides employment to millions of people (BAHS 2019). An increasing population, greater purchasing power and urbanization are the strong drivers for this growth. During the year 2022-2023, in India 4.99 million tonnes poultry meat production estimated with a contribution of 51.14% in total meat production (BAHS, 2023). India export poultry products of about 664,753.46 MT, costing of worth Rs. 1081.60 Crores/134.04 USD Millions (APEDA).

Meat and meat products are prosperous sources of nutrients (Brewer, 2012). However, chicken meat and its products have experienced an increasing popularity throughout the world. It has a great appeal because of its flavour, texture and delicacy. Due to high nutritive value, easy availability and low price of chicken meat, it becomes a vital component of non-vegetarian group of people diet. Therefore per capita availability of chicken meat is slightly stronger in developing countries than other nations. Customers are also fascinating towards ready to eat chicken products due to progression of their economic status and industrial development.

Poultry meat is a nutritious food with high protein, vitamins and mineral content. It is richest source of vitamin B12. It is also a heart healthy food as half of the chicken fat contributes to desirable monounsaturated fats with no trans-fat and very less to unhealthy saturated fat. It is also an important provider of the essential polyunsaturated fatty acids (PUFAs), especially the omega (n)-3 fatty acids. Poultry meat can be enriched with several important dietary nutrients like selenium, to cope up its deficiency in human body as soils are becoming depleted with no selenium in the foods grown on them (DAHD, 2020).

Grains like maize, millet, wheat, rice which are rich in carbohydrate contribute enormously in human diets but these does not contain adequate protein to sustain individual health needs. Milling of grains provides a finer texture

distributing enormously fiber available in its outer coating. Wheat is a crucial grain playing a significant role in the nutrition of 40% of the population around the world. However, the nutritional quality of wheat may lag behind some foodstuffs due to lack of protein content, with some essential amino acids (lysine) and the availability of antinutritional factors such as phytic acid, tannins and polyphenols (Kaur and Gill, 2020).

Snacks are generally important part of adoring consumers diet. These products are made from natural ingredients or components to have specified functional properties (Garriguet 2006). Snack products are mostly liked by children and women's due to its unique taste and palatability. Approximately 20-50 percent Asian population include wheat flour in their diet in the form of snacks (Hou, 2010).

Snack food is very popular throughout the India. Nimki or nimkin (or namkin) is a crunchy savoury snack eaten in the Indian subcontinent. It has a synonym is Namak para or namakpare, which resembles with Mathri prepared in Rajasthan, parts of Punjab and Uttar Pradesh. The sweet version of this snack prepared in Maharashtra and named as Shakkar pare (Shankarpali). Bite or namkeen para is a deep fat fried tea-time snack item. Traditionally, Bite is a prepared very simply using refined wheat flour (maida) with incorporation of common salt, spices and fat. Snack foods being mostly cereal based, which are either poor sources of protein or contain proteins of poor nutritional quality. Its consumption is associated with high intakes of sucrose, refined starch and carbohydrate with low intakes of fibre, vitamins or minerals (Howarth *et al.* 2007). However, consumers with dietary restrictions gaze at snacks as a healthy dietary solution (Goulet *et al.* 2008) and demanding for high protein and low fat containing snack products.

Chicken meat is one of the most recommended meats by experts, to incorporate high quality proteins and nutrients into our diet. Preparation of meat-based snacks products cater to the consumer demand for high protein and low fat extruded products as well increases the palatability and acceptability of the

products. Meat based snacks can be produced using meat as a basic component of formulation in combination with cereals grains (Chung *et al.* 1989).

Looking towards the demand of consumers and international market, there is need to develop nutrient rich flour based snack product. Incorporation of chicken meat in snacks increases protein as well as vitamins and mineral content (Verma *et al.* 2014). The use of chicken meat in the development of bites will open novel chances for lucrative utilization of chicken as well as augment the nutritional aspect of the product. Thus, the present study is planned with an objective of development of protein rich chicken meat-based bites with addition of wheat flour.

OBJECTIVES:

1. To optimize the level of whole wheat flour in chicken bites.
2. To evaluate shelf life of chicken bites at room temperature.
3. To study the cost structure of chicken bites.



Review of Literature



CHAPTER – II

REVIEW OF LITERATURE

Snacks are generally important food item of the many food adoring consumers. It is mostly consumed by children's women's and younger population due to its unique taste, palatability and fast cooking property. Approximately 20 to 50 percent people of Asian countries prefer refined wheat flour in the form of snacks (Hou, 2010). However, incorporation of chicken meat in snack product increases protein, vitamins and minerals availability to consumers (Verma *et al.* 2014). Therefore, development of chicken meat based snacks products is a novel chance for lucrative utilization of chicken as well as augment the nutritional demand of consumers.

2.1 Chicken meat

Meat and meat products are prosperous sources of nutrients (Brewer, 2012). It is a vital component of diet of non-vegetarians group of people as it has higher amount of proteins, low fat and calories. Chicken meat has great appeal because of its flavour, texture and delicacy, which is the most popular meat consumed extensively worldwide as it is often inexpensive, low in fat more hygienic, cardiac healthy food with no religious and cultural restrictions.

Devi *et al.* (2014) stated that consumption of meat obtained from different food animal largely depend on the religion. As pork consumption is prohibited by Muslim and beef is forbidden to Hindu population. However, chicken meat highly preferred universally due to no any religious taboo.

Marangoni *et al.* (2015) revealed that ample amount of essential nutrients available in chicken meat can play a crucial role in the diet of individuals of specific age group (pregnant women, children and elder people). Its consumption also reduces the risk of cardiovascular diseases, diabetes, overweight and tumors.

Jaiswal *et al.* (2015) enumerated the presence of all essential amino acids in chicken meat, which are qualitatively comparable with milk and egg proteins.

Zhang *et al.* (2016) reported a comparatively high concentration of polyunsaturated fatty acids in chicken meat.

Kralik *et al.* (2018) noted that the chicken meat has superior nutritional qualities due to less fat and high-quality protein.

The poultry sector continues to grow and industrialize in many parts of the world, which contributes to the national GDP as well as provides employment to millions of people (BAHS 2019). An increasing human population, greater purchasing power and urbanization have been strong drivers of this growth. Presently India produces 4.99 million tons of poultry meat production during the year 2022-2023, showing 51.14% contribution of total meat production (BAHS, 2023).

2.2 Wheat flour

Wheat is a crucial grain that plays a significant role in the nutrition of 40% of the population around the world. However, the nutritional quality of wheat may lag behind some foodstuffs, because of its low protein content, lack of some essential amino acids (lysine) as well as presence of antinutritional factors such as phytic acid, tannins and polyphenols (Kaur and Gill, 2020).

Barfal *et al.* (2017) developed fiber enriched and low gluten containing nutritious quality bites by replacing refined wheat flour with rice, pearl millet and okara flours. They observed higher sensory attributes for all bites except control bites which were prepared only from maida. Bites produced from composite flour had about 10 times more fiber and calcium as compared to control bites.

Jamaly *et al.* (2017) concluded that 5% wheat flour can be incorporated as a source of dietary fiber and functional ingredients i.e. prebiotic in meat ball.

Islam *et al.* (2018) represented significantly ($P < 0.05$) acceptance for meatballs having 15% wheat flour.

Kumar *et al.* (2019) prepared noodles by incorporating various levels (10-50%) of chicken mince meat (CMM), chicken meat powder (CMP) separately in refined wheat flour.

Gomez *et al.* (2020) also stated that consumption of wheat products fulfills the consumption requirement of carbohydrates dietary fiber, proteins and bioactive compounds of human being.

Zhang (2020) stated that wheat products have higher water absorption, water solubility and radical expansion rate, which is also varies with the quality of wheat flour.

Nimitkeatkai *et al.* (2022) added wheat flour in meat-based snacks using beef scraps,

2.3 Chicken snacks

Chicken snacks are deep-fried chicken meat-based food products which are generally prepared with combination of minced chicken meat and wheat flour and addition of common salt, spices and fat.

Senthil *et al.* (2002) developed fried savory and sweet snacks prepared using different combinations of wheat flour and defatted soya flour (65:20, 60:25, 55:30 and 45:40).

Verma *et al.* (2013) added different level of chicken meat (30%,40%,50%) in whole wheat flour and rice flour-based noodles.

Singh *et al.* (2015) developed chicken caruncles with incorporation of different fillers i.e. rice flour, tapioca starch and potato starch.

Pal *et al.* (2017) incorporated egg yolk powder (EYP) and chicken mincemeat (CMM) at different levels (5, 10 and 15%, w/w) as a poultry-based ingredients in noodles.

Gamit *et al.* (2020) prepared chicken meat cutlet with incorporation of different level of (5, 10, and 15%) finger Millet (*Eleusine coracana*) Flour.

Oyeniran *et al.* (2021) developed wheat noodles with incorporation of 10% spent hen chicken meat powder which enhanced its nutritive value thereby facilitating growth especially of children in poor nations.

Bhosale *et al.* (2021) prepared multigrain extruded chakli with a objective of value addition and production of healthy food. They stated that multigrain chakli had significantly improved nutritional value.

Yashodhan *et al.* (2022) studied the effect of millet flours on the quality of ready-to-eat type of snack food such as egg chips.

2.4 Quality parameters

2.4.1 Proximate composition

Chang and Carpenter (1997) observed decrease in moisture and fat content on addition of oat bran in chicken frankfurters.

Senthil *et al.* (2002) studied dough characteristics and quality of fried savory and sweet snacks prepared using different combinations of wheat flour and defatted soya flour (65:20, 60:25, 55:30 and 45:40). They observed slight increase in water absorption and decrease in dough stability with increase in the level of soya flour. At the same time they stated that the protein content was increased gradually from 20.75 to 27.50% in fried savory snack.

Eyidmir and Hayta (2009) observed increase in ash and protein content in apricot kernel flour (AKF) incorporated noodles.

Kumar *et al.* (2010) developed chicken patties with incorporation of various levels (15%, 20%, 35%, 50%) of oat bran. They found decrease in moisture and fat content with increase in the level of oat bran.

Chin *et al.* (2012) observed significant higher ($P < 0.05$) the ash, protein and fat content in surimi powder incorporated wet yellow noodles than control.

Verma *et al.* (2014) developed chicken meat noodles by using different levels (0, 30, 40 and 50 percent) of chicken meat in the formulation. They observed non-significant increase in moisture content, while significant ($P < 0.05$) increase in protein, fat, ash content.

Gupta *et al.* (2015) carried out experiment to develop spent hen meat blocks with incorporation of different level of oat meal (4%, 6% and 8%) by replacing the lean meat. They observed gradual decrease in the moisture and protein percentage in restructured spent hen meat blocks with an increase in the level of oat meal.

Chatli *et al.* (2015) recorded increase in protein and fat content with increase in the level of finger millet flour (4%, 6 % and 8%) in emu meat nuggets.

Singh *et al.* (2015) carried out experiment for the development of chicken meat caruncles with addition of different levels flour (22.75% refined wheat flour + 12.25% rice flour), (14.00% refined wheat flour + 21.00% tapioca starch) and (35.00% potato starch). Result showed substantially higher moisture, protein and ash content in all treated samples ($P < 0.05$) than in control chicken meat caruncles.

Zhuang *et al.* (2016) added sugarcane dietary fiber in beef burgers due to which the fat content decreased in the product, resulting in decrease in cholesterol level.

Tamsen *et al.* (2018) studied an the effect of substitution of wheat flour (0, 50 and 100% levels) with amaranath flour in chicken nuggets. They concluded that the addition of amaranath flour in chicken nuggets significantly increases ($P < 0.05$) fiber, fat, and protein content of the product.

Nawaz *et al.* (2019) observed significant ($P < 0.05$) increase in protein, fat, moisture and ash contents in red fish meat added snack product.

Gamit *et al.* (2020) observed significantly higher ($P < 0.05$) crude fiber and calcium content in finger millet flour treated chicken cutlets as compared to control, depicting marked improvement in the desirable food trait with health benefits.

Bahgaat *et al.* (2022) incorporated different levels (5,10,15 and 20%) of oggtt in cooked noodles and they observed increase in the protein, fat and ash content in oggtt supplemented noodles.

Philomina (2022) evaluated the nutritional value of chin-chins made with using wheat flour and chicken meat flour. Result showed increase in fat, ash and protein contents with increased level of wheat flour.

Ogundipe *et al.* (2023) added wheat and sweet potato flour blends as a fat replacer in beef patties. They found increase in the protein content with increase in the level of wheat flour, while decreased fat content with inclusion of sweet potato flour into the beef patties.

Sagi *et al.* (2023) prepared chicken meatballs with incorporation of various levels (0%, 10% and 20%) of potato puree by replacing lean meat in the

formulation. They recorded significantly ($P<0.05$) decrease in crude protein, fat, ash, energy content while increase in moisture content of the chicken meatballs with increasing levels of potato puree.

2.4.2 Physico-chemical properties

2.4.2.1 pH

Yilmaz and Daglioglu (2003) found increase in pH with increase in level of oat bran (5, 10, 15 and 20%).

Reddy *et al.* (2012) found increase in pH on addition different level of (3%, 6% and 9%) oat flour in low-fat chicken sausages.

Verma *et al.* (2014) found decrease in pH value with increase in the level of minced chicken meat (0, 30, 40 and 50%) in flour based noodles.

Gupta *et al.* (2015) found increase in pH with incorporation of various level of (4%, 6% and 8%) of oat meal in spent hen meat blocks.

Singh *et al.* (2015) stated significantly ($P<0.05$) higher pH value in control meat caruncles than) treated caruncles containing different flour (22.75% refined wheat flour + 12.25% rice flour), (14.00% refined wheat flour + 21.00% tapioca starch) and (35.00% potato starch).

Nayar *et al.* (2015) developed dehydrated goat meat cubes using different formulations (80 % meat mince+10 % Bengal gram-based binder mix (HBE), 70 % meat mince+20 % green gram based binder mix (HGR), 80 % meat mince+10 % black gram based binder mix (HBL) and 80 % meat mince+10 % lentil based binder mix (HLE). They found (6.53 ± 0.01) was significantly higher ($p<0.01$) pH for HGR than other formulation.

Mehta *et al.* (2015) stated that incorporation of dietary fibers obtained from different sources in meat products helps to enhance desirability of meat products.

Das *et al.* (2015) noticed no discernible difference in pH of the control and carrageenan (Cgn; 0.5% w/w), finger millet flour (FMF) and sorghum flour (SF; 10%w/w) treated chicken patties.

Kumar *et al.* (2016) observed significantly lower ($P < 0.05$) pH values in wheat bran and oat bran fiber-enriched chicken meat biscuits than control.

Tamsen *et al.* (2018) recorded higher pH values for amaranth flour treated nuggets than the control.

2.4.2.2 Cooking yield

Yusnita *et al.* (2007) studied on effects of three types of flours, namely wheat, rice and sago on the processing parameters of fried battered chicken wing. They found improvement in the cooking yield on addition of wheat flour in the product.

Ikhlas *et al.* (2011) developed quail meatballs by using 3% of potato, cassava, sago corn and wheat flours separately in formulation. Result showed highest cooking yield for the quail meatball formulation using potato flour (98.97%).

Prasad *et al.* (2011) reported significantly higher ($P < 0.05$) product yield for oat flour and casein treated steam cooked kofta.

Mirhosseini *et al.* (2015) observed increased in cooking yield of gluten-free pasta prepared by partial replacement of corn flour with both pumpkin flour and durian seed flour.

Talukder (2015) reviewed that the cooking yield of meat products could be increased by adding dietary fibre.

Singh *et al.* (2015) developed chicken meat caruncles using different fillers. They observed significantly higher ($P < 0.05$) cooking yield in (14.00% refined wheat flour + 21.00% tapioca starch) followed by (35% refined wheat flour), (22.75% refined wheat flour + 12.25% rice flour) and then (35.00% potato starch).

2.4.2.3 Oil absorption

Shih *et al.* (1999) observed higher oil absorption in wheat flour treated fried batters as compared to rice flour treated fried batters.

Peska *et al.* (2010) observed highest oil absorption in wheat bran added potato pellets fried snacks than corn bran and corn germ addition.

Dueik *et al.* (2014) observed increase in oil absorption on addition of large amounts of fiber in low-fat gluten matrix.

Amini *et al.* (2015) employed hydrocolloids in meat products to enhance functional qualities and counteract the negative effects of salt reduction, fat reduction and freeze/thaw processing. They stated that addition of hydrocolloids in coating batter in poultry nuggets decrease oil absorption and promotes moisture retention during frying.

Tamsen *et al.* (2018) reported significantly ($P < 0.05$) higher oil absorption in nuggets on addition of amaranth flour by substituting wheat flour (0, 50 and 100%) in the formulation.

Habeebrakuman *et al.* (2019) observed higher oil absorption for deep fried wheat flour based snacks than soy flour and gram flour based snacks.

Tanna *et al.* (2020) observed variation in oil absorption percentage on addition of different flours viz, rice flour, wheat flour, and Bengal gramme flour for the preparation of value-added snack (fish chakli) using potted seer fish powder (*scomberomorus guttatus*)

2.4.3 Sensory quality

Surender *et al.* (2011) developed noodles with different level (10-50%) of chicken meat mince (CMM) and refined wheat flour. They observed more acceptability for containing 20% CMM noodles than other levels.

Verma *et al.* (2014) observed significantly higher ($P < 0.05$) sensory attributes for 30% chicken meat containing noodles except meat flavour intensity while meat flavour intensity was found significantly ($P < 0.05$) higher in 50% chicken meat than other products.

Singh *et al.* (2014) optimized the level of potato starch in chicken meat caruncles. Potato starch was replaced with 60%, 80% and 100% refined wheat flour. They found best colour and taste as well as significantly higher ($p < 0.05$) sensory attributes for 100 percent potato starch replacement.

Verma *et al.* (2015) stated that the incorporation of chicken meat in the noodles improves the nutritive values and sensory attributes.

Khare *et al.* (2015) developed chicken noodles with desired sensory quality using optimum conditions such as 60 % meat level, with 12 min steaming time and 9 hrs drying time.

Singh *et al.* (2015) developed chicken meat caruncles using different fillers. They observed significantly higher ($P<0.05$) sensory attributes viz. colour/appearance, crispiness, meat flavour intensity and overall acceptability in (14.00% refined wheat flour + 21.00% tapioca starch) than (35% refined wheat flour), (22.75% refined wheat flour + 12.25% rice flour) and (35.00% potato starch) chicken meat caruncles.

Singh *et al.* (2015) replaced lean meat with different binders viz. 3% refined wheat flour (T1) and 3% rice flour (T2) in preparation of chicken meat cutlets. Juiciness score was significantly ($P<0.05$) higher for treatment as compared to control. Overall acceptability of cutlets with refined wheat flour (T1) was significantly ($P<0.05$) higher than control and comparable with T2.

Pal *et al.* (2017) observed higher sensory scores for noodles prepared with incorporation of 10% (w/w) egg yolk powder (EYP) and 15% (w/w) chicken mince meat.

Islam *et al.* (2018) represented significantly ($P<0.05$) higher acceptability for meatballs having 15% wheat flour, which was found best with higher consumer preference in terms of colour, odour, tenderness, juiciness.

Kumar *et al.* (2019) prepared noodles by incorporating various levels (10-50%) of chicken mince meat (CMM), chicken meat powder (CMP) separately in refined wheat flour. They observed highest acceptability for 20% CMM and 20% CMP enriched noodles than other treatments and control during 60 days storage.

Harikrishnaa *et al.* (2020) recorded significantly ($P<0.05$) higher juiciness and tenderness scores for chevon cutlets prepared with incorporation of radish paste than potato.

Nimitkeatkai *et al.* (2022) added wheat flour in meat-based snacks using beef scraps, which was contributed to a firm texture to the products, resulting in significantly ($p < 0.05$) higher sensory scores for texture.

2.5 Shelf life

2.5.1 Proximate composition

Verma *et al.* (2015) stated that the moisture content increased significantly ($P < 0.05$) at the 30th day of storage in control and on 20th and 30th day in 40% chicken meat added refined wheat flour noodle. The fat, protein and ash content decreased in both treatment as well as control noodle during storage.

Chowdhary *et al.* (2017) prepared fish balls by combining fish mince powder with potato flour and other ingredients and concluded that fish ball containing higher percentage of fish mince powder had more protein, fat and ash content. The moisture content increase with storage period.

Bahgaat *et al.* (2022) observed increase in protein, fat and ash with the increase different level (5,10,15 and 20%) of oggtt in noodles.

More *et al.* (2019) found significantly ($P < 0.05$) decrease moisture content in quail mince meat (0%, 40%, 50% and 60%) incorporated wheat flour noodles during storage at room temperature ($35 \pm 2^\circ\text{C}$).

Singh *et al.* (2011) observed non-significant ($P > 0.05$) decrease in moisture content of chicken snacks during storage under vaccum packaged at room temperature.

2.5.2 Physico-chemical parameters

Verma *et al.* (2015) observed significantly ($P < 0.05$) increase in TBARS value in 0 and 40 percent chicken meat incorporated noodles during 30 days ambient temperature storage period.

Kumar *et al.* (2016) developed fiber-enriched chicken meat biscuits with incorporation of wheat bran and oat bran at three different levels i.e., 3%, 5 % and 7%. They recorded significantly ($P < 0.05$) lower pH and higher water activity value in treated biscuits during entire storage.

Cakmak *et al.* (2016) observed higher TBA value for whole wheat bread snack made with 15% of chicken meat during storage.

Tamsen *et al.* (2018) noted lower TBA value for amaranth flour treated nuggets than control sample during refrigerated storage of 13 days.

Tabassum *et al.* (2018) observed increasing trend in TBARS values from 0 to 60 days in whole wheat flour, refined wheat flour and dehydrated chicken powder treated chicken ravioli.

Islam *et al.* (2018) recorded significant ($p < 0.05$) increase in TBARS values with storage time, showing decrease in shelf life of meatball formulated with addition of different level (0%, 5%, 10% and 15%) of wheat flour.

Saini *et al.* (2019) stated that integration of 3% rosemary leaves extract had a highly significant ($p < 0.01$) effect on thiobarbituric acid reactive substances, free fatty acid and tyrosine value of ready-to-eat shelf stable fried chicken snacks.

More *et al.* (2019) found considerable increase in tyrosine and thiobarbituric acid reactive substances (TBARS) value in quail mince meat (0%, 40%, 50% and 60%) incorporated wheat flour noodles during storage at room temperature ($35 \pm 2^\circ\text{C}$), which were within the spoilage limit up to 60 days of storage period.

Nemade *et al.* (2021) reported that the TBA and tyrosine values increased considerably during ambient ($37 \pm 1^\circ\text{C}$) storage of cookies prepared with incorporation of spent hen meat powder prepared by replacing pearl millet flour, but these values were found within the spoilage limit up to 60 days of storage period.

2.5.3 Sensory quality

Ahamed *et al.* (2007) observed decrease in flavour scores during refrigerated storage of enrobed buffalo meat cutlets.

Singh *et al.* (2011) also observed a similar decreasing trend in meat flavour intensity scores during storage of chicken snacks.

Verma *et al.* (2015) stated that the overall acceptability of the control noodles did not differ significantly ($P < 0.05$) throughout storage, however this value decreased significantly ($P < 0.05$) in 40% chicken meat treated noodles.

More *et al.* (2018) studied decrease in juiciness and texture scores during storage of quail meat enriched noodles at room temperature

Islam *et al.* (2018) reported higher consumer acceptability for 15% wheat flour treated meatballs among the treatments and control during 30 days storage of room temperature.

Kumar *et al.* (2019) recorded higher acceptability for noodles incorporated with 20% chicken mince meat and 20% chicken meat powder stored at room temperature. The noodles were found suitable for consumption even after 60 days of room temperature storage.

2.5.4 Microbiological quality

Cakmak *et al.* (2013) detected yeast-mold count and aerobic plate count within detectable ranges and no coliform bacteria during the storage of chicken meat added bread formulation.

Raja *et al.* (2014) observed significant increase ($P < 0.05$) in plate count (log cfu/g) and yeast and mould count (log cfu/g) during ambient storage of aerobically packaged control as well as 20% corn flour, 10% black gram flour and 10% peanut flour added fish curls.

Das *et al.* (2015) studied the effect of substitution of fat in chicken patties with sorghum flour, finger millet flour, and carrageenan on the total plate count. They found significant ($P < 0.01$) increase in total plate count in all samples during storage.

Verma *et al.* (2015) observed significant increase ($p < 0.05$) in total plate count as well as yeast and mould count during the aerobic storage of chicken meat-based noodles at room temperature.

Nayar *et al.* (2015) utilized various legume-based binder mixtures to extend the shelf life of hot air oven-dried goat meat cubes. They found total plate

count as well as yeast and mould count within acceptable limits in all goat meat cubes during storage.

Nemade *et al.* (2021) recorded considerable increase in TPC, yeast and mould counts in spent hen meat cookies throughout ambient storage period, but these values were found within the spoilage limit up to 60 days.

Bhumre *et al.* (2023) noted increase in total plate counts with increased storage period of noodles enriched with chicken eggs (0%, 10%, 20%, and 30%) but were remained under the spoilage limit for the first 40 days of storage ($35\pm 1^{\circ}\text{C}$).

2.5.5 Cost of Production

Berwal and Khanna (2013) estimated Rs. Rs.63.72 and 77.60 cost for 1 kg control and 10% chicken mince meat cookies respectively.

Verma *et al.* (2013) estimated lower cost for 30% chicken meat added wheat flour noodles than the cost of 50% chicken meat added rice flour noodles. Consequently, they observed that the incorporation of whole wheat flour is more cost-effective than rice flour in chicken meat noodles.

Kapse (2016) recorded Rs.145.72/- and Rs.191.32/- costs for production of 1 kg of 20% and 30% chevon enriched wheat flour based noodles respectively.

More *et al.* (2018) recorded Rs. 159.24/- overall cost for production of one kg control noodle whereas Rs.176.74/-, Rs.206.74/- and Rs.236.74/- cost respectively for 40%, 50%, and 60% quail mince meat supplemented wheat flour based noodles.

Mehak *et al.* (2018) reported that the cost Rs.11,314.5 of formulation of 100 kg control egg kofta and cost Rs.9714.5, Rs.8914 and Rs.8114.5 for added boiled shredded bottle gourd with 20%, 30%, and 40% egg kofta was respectively.

Bhumre *et al.* (2023) estimated Rs. 34.90/- cost for producing one kilogram of control noodle which was lower than the cost of 10% (Rs.42.40/-), 20% (Rs.49.40/-) and 30% (Rs.47.40/-) chicken eggs added wheat flour based noodles.



Materials and Methods



CHAPTER - III

MATERIAL AND METHODS

3.1 Source of raw material

3.1.1 Chicken meat

The chicken meat slaughtered by traditional halal method was procured from local meat market of Parbhani city, Maharashtra. Adequate care was taken while bringing meat from meat market to the laboratory. The tendons, connective tissues and body fat were separated and the meat was packed in low density polyethylene pouches (LDPE). Packed meat was kept for conditioning in a refrigerator at $4\pm 1^{\circ}\text{C}$ for 6–8 hrs and then frozen at -18°C till further use.

3.1.2 Wheat flour

Wheat flour of the standard brand was procured from the local market of Parbhani city. Nutritional fact of wheat flour per 100 gm given in the Table 3.1

Table 3.1 Nutritional composition of wheat flour (per 100 g)

Sr No	Nutritional component	Amount
1	Energy	340 Kcal
2	Protein	13.2 gm
3	Total fat	2.5 gm
4	Carbohydrates	61.3 gm
5	Fiber	10.7 gm
6	Calcium	34 mg
7	Iron	3.6 mg
8	Magnesium	137 mg
9	Phosphorus	357 mg
10	Potassium	363 mg

(Iqbal *et al.*2022)

3.1.3 Spice mix

Composition of spice mix mainly include red chilli powder, coriander powder (Dhania), cumin (Jeera), compounded asafetida (Hing), turmeric powder (Haldi), clove (Laung), black pepper (Kali mirch), trifala, nutmeg, dalchini, small iliachi, badi iliachi, soaf etc. These components were dried in a hot air oven at 60°C. for 2 hours for removal of moisture. Thereafter these spices well grinded in grinder and sieved through a mesh to remove foreign particles. The prepared spices were packed in airtight LDPE pouches, stored at refrigeration temperature and used as per the requirement during research work.

Table 3.2 Composition of spice mix

Sr no	Ingredient	Quantity (% by weight)
1	Red chilli powder	10
2	Coriander powder (Dhania)	15
3	Soaf	10
4	Cumin (Zeera)	20
5	Turmeric powder(Haldi)	5
6	Dalchini	2.5
7	Clove (Loang)	5
8	Black Pepper (Kali mirch)	10
9	Trifala	5
10	Nutmeg	5
11	Asafetida	5
12	Badi iliachi	5
13	Small iliachi	2.5
	Total	100

3.1.4 Other ingredients

Corn starch, ajwain, common salt, refined sunflower oil were purchased from near local market.



Plate 3.1 Raw ingredients used for preparation of chicken bites.



Plate 3.2 Chicken bites dough

3.1.5 Condiments mix

Condiments used in the study viz. ginger and garlic were purchased from the local market. The fresh, clean ginger and garlic were cut into small pieces after peeling off the external coverings. The cut pieces of garlic and ginger weighed to 1:2 ratios and ground in a grinder for 2-3 minutes till the formulation of fine pasty consistency obtained.

3.1.6 Chemicals

All the chemicals used in the study were of analytical grade and procured from Dodal Enterprises, Aurangabad

3.1.7 Microbiological Media

The culture media used in the study were procured from Hi Media Laboratories (P) Ltd, Mumbai.

3.1.8 Packaging materials

Low-density Polyethylene (LDPE) bags of 250 gauges of natural color were procured from the local market. These LDPE bags were sterilized by exposing them to U.V. light for 30 minutes before use.

3.2 Formulation of chicken bites

Chicken bites were prepared by replacing whole wheat flour with different level of chicken meat. (65%, 75%, 85%).

Table 3.3 Basic formulation of chicken bites Quantity (% by weight)

Sr. No.	Ingredients	Treatment			
		C	WF-35	WF-25	WF-15
1	Minced chicken meat	-	43.8	50.60	57.37
2	Flour (wheat flour)	67.5	23.7	16.9	10.12
3	Salt	1.5	1.5	1.5	1.5
4	Baking soda	0.5	0.5	0.5	0.5
5	Condiments	3	3	3	3
6	Oil	8	8	8	8
7	Spices	2.5	2.5	2.5	2.5
8	Ajwain	5	5	5	5
9	Corn starch	4	4	4	4
10	Cold water	8	8	8	8
11	Total	100	100	100	100

C = Bites with 100% whole wheat flour

WF-35 = Bites with 35% whole wheat flour and 65% chicken meat

WF-25 = Bites with 25% whole wheat flour and 75% chicken meat

WF-15 = Bites with 15% whole wheat flour and 85% chicken meat

3.2.1 Preparation of chicken bites

Frozen deboned meat was cut into pieces and minced in a meat mincer after thawing at room temperature. Other ingredients like wheat flour, vegetable oil, spices mix were mixed with minced meat in bowl chopper. Bites were prepared as per the method used by Barfal *et al.* (2017) with slight modification as per the following flow chart

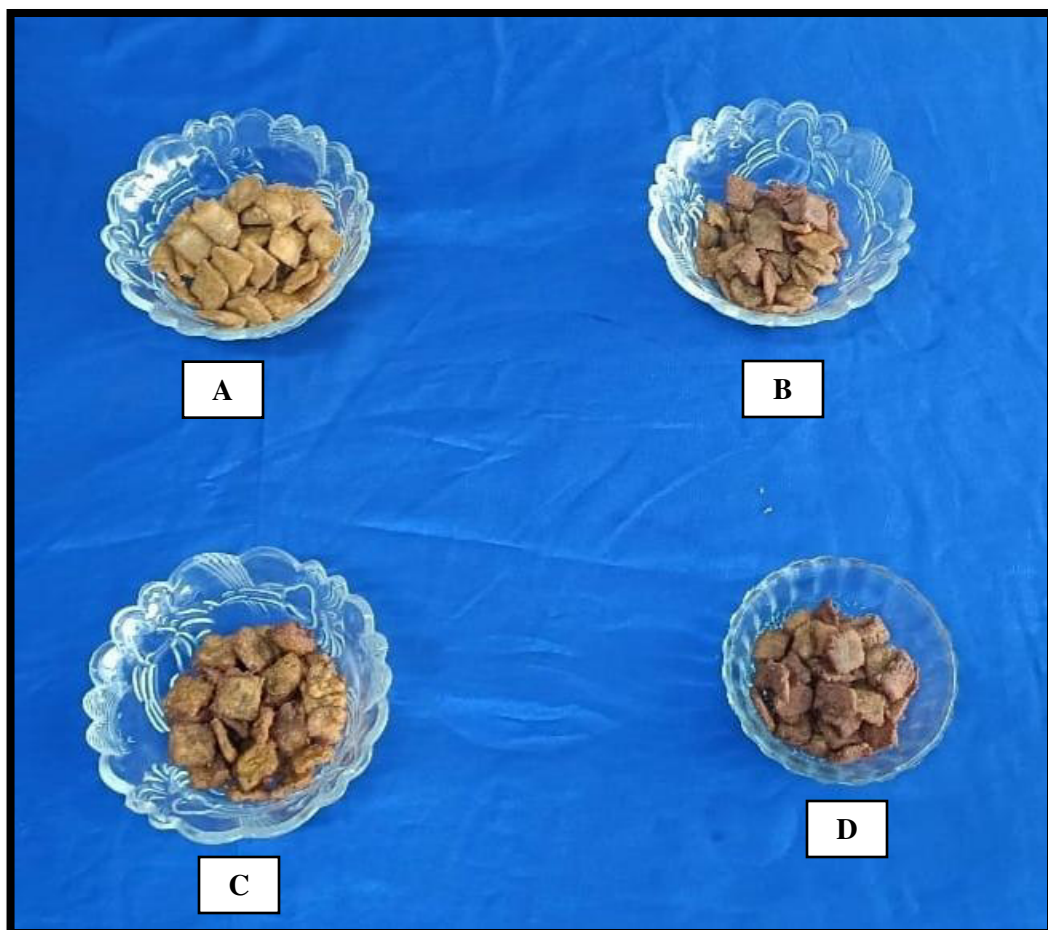


Plate 3.3 Chicken bites prepared with wheat flours

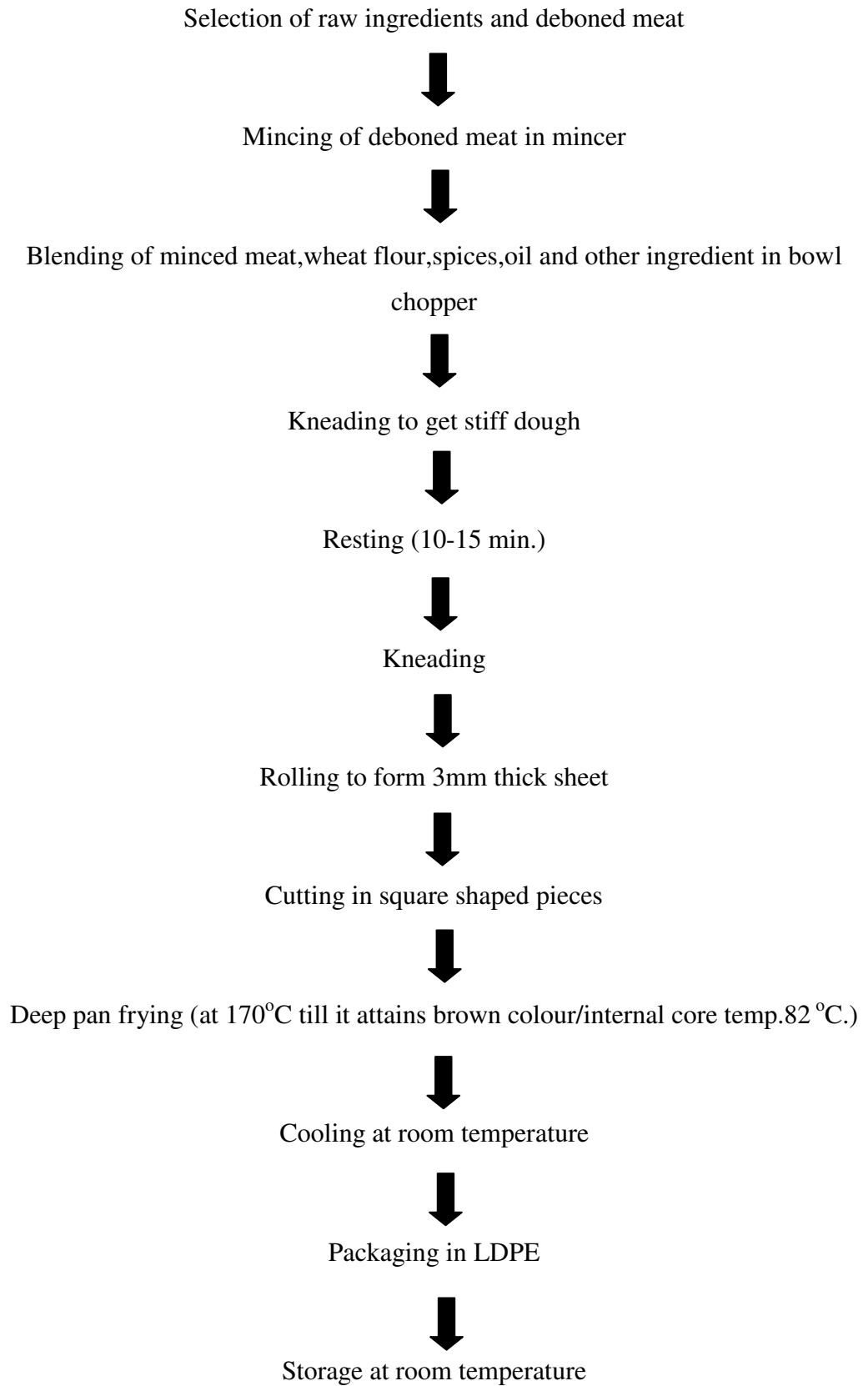
A – (Control) 100% whole wheat flour

B- 35% whole wheat flour + 65% chicken meat

C- 25% whole wheat flour + 75 % chicken meat

D- 15% whole wheat flour + 85% chicken meat

Flow chart for the preparation of chicken bites



3.3 Experimental details

3.3.1 Effect of whole wheat flours on quality characteristics of chicken bites.

Chicken bites were made by mixing various levels (100%, 15%, 25%, and 35%) of whole wheat flours and chicken meat (0%, 65%, 75%, 85%). The acceptable level of chicken meat and wheat flour was selected on the basis of proximate composition, physico-chemical parameter such as pH, cooking yield, oil absorption, and sensory evaluation.

3.3.2 Shelf life of wheat flour incorporated chicken bites stored at room temperature.

The objective of this experiment was to assess the shelf life of chicken bites during storage at room temperature. Chicken bites prepared by using selected level of whole wheat flour was aseptically packed in LDPE pouches and stored at room temperature. These chicken bites were assessed for changes in physico-chemical, microbiological quality and sensory attributes at regular interval of 10 days till incipient spoilage.

3.3.3 Cost structure of chicken bites

The overall cost of developed chicken bites fortified with wheat flour was calculated by considering the actual price paid for the purchasing of the different material as per formulation.

3.4 Analytical procedures

3.4.1 Proximate composition

The moisture, fat, protein, crude fiber and ash content of chicken bites were measured as per the method of AOAC (1995).

3.4.1.1 Moisture

Ten gram of chicken bites sample was kept in hot air oven and dried at (100±2°C) until constant weight was observed in subsequent weighing and loss in weight was recorded as moisture content and expressed as %.



Plate 3.4 LDPE packed control bites



Plate 3.5 LDPE packed bites incorporated with 25% wheat flour

$$\text{Moisture \%} = \frac{\text{Fresh weight (g)} - \text{Dry weight (g)}}{\text{Fresh weight (g)}} \times 100$$

3.4.1.2 Fat

The fat content of chicken bites was calculated using the soxhlet extraction technique. The moisture-free sample was pulverized and extracted in a soxhlet device with petroleum ether (40 to 60°C). Allow the equipment to run for a sufficient amount of time until all of the fat in the sample has dissolved in the petroleum ether. The ether extract was exposed to a hot air oven to entirely eliminate the petroleum ether from the extract, and it was weighted as fat.

$$\% \text{ Fat} = \frac{\text{Weight of fat (g)}}{\text{Weight of sample (g)}} \times 100$$

3.4.1.3 Protein

The total nitrogen content of the chicken bites was calculated using Kjeldahl's technique, which involved converting nitrogen to ammonia and titrating it. The protein content was calculated by multiplying the nitrogen content by 6.25. This method consists of three phases –

Digestion

The structure and chemical bonds that keep protein molecules together were broken down during digestion, and amino nitrogen is transformed into ammonium radical. It is a controlled thermal oxidative degeneration of a sample in concentrated sulphuric acid in the presence of Potassium sulphate and Copper sulphate as catalysts. This catalyst combination boosts the boiling point of sulphuric acid and reduces the digesting time.

Distillation

Distillation is the process of separating and isolating nitrogen from a digested mixture. This was accomplished by raising the pH using NaOH. The ammonium radical was converted to ammonia as a result of this. The ammonia was distilled and collected in a trapping medium containing 4% boric acid.

Titration

The amount of nitrogen was determined by titrating with a standard solution of 0.1N HCl in presence of mixed indicator.

3.4.1.4 Ash

Clean crucibles were placed under a muffle furnace at 600 °C for one hour. Crucibles were moved from the furnace to a desiccator and cooled to room temperature. These crucibles were weighed quickly to prevent moisture absorption. 2.0 gm of chicken bites sample was added into dried silica crucibles. Placed in a muffle furnace and the temperature were held at 600 °C for 6 hours. The crucibles were taken to a desiccator and cooled to room temperature. After cooling crucibles, were weighed quickly to prevent moisture absorption.

$$\% \text{ Total Ash} = \frac{\text{Weight of residue (g)}}{\text{Weight of sample (g)}} \times 100$$

3.4.1.5 Crude fiber

The crude fiber of chicken bites was estimated as per AOAC (1995). Moisture and fat free sample was boiled with 1.25 percent sulphuric acid solution for 30 minutes and followed by filtration and repeated washing with hot neutral water to make acid free. This was followed by boiling the residue with 1.25 percent sodium hydroxide solution for 30 minutes and washed with hot neutral water. Residual sample with crucible was dried, weighed and then ignited in muffle furnace to obtain its ash content. Crude fiber was calculated by deducting ash from the weight of dried residue, which was expressed on percent dry matter basis

$$\text{Crude Fiber (\%)} = \frac{\text{Loss in weight}}{\text{Weight of sample}} \times 100$$

3.5 Physico-chemical parameter

Chicken bites were subjected for the analysis of following physico-chemical parameter.

3.5.1 pH

The pH of chicken bites was tested using the Troutt *et al.* (1992) technique. The pH of the samples was measured using a digital pH meter after ten gram of cooked chicken bites was combined with 100 ml of distilled water.

Prior to measurement, the pH meter was calibrated every time as per the manufacturer's instructions using known buffers of pH 7.0 and 4.0. Reading was taken twice for each sample and the average of the reading was taken as the pH of the sample.

3.5.2 Oil absorption

The percentage of Oil absorption of chicken bites was analyzed by using standard method used by Mohamed *et al.* (1988)

$$\text{Oil absorption} = \frac{\text{Weight of bites before frying} - \text{Weight of bites after frying}}{\text{Weight of bites after frying}} \times 100$$

3.5.3 Cooking yield

The weight of chicken bites was taken before and after frying and expressed in percentage. The percent cooking yield of chicken bites was analyzed by using standard method used by Berry *et al.* (1993)

$$\text{Cooking yield} = \frac{\text{Weight of chicken bites after frying}}{\text{Weight of chicken bites before frying}} \times 100$$

3.6 Shelf life study of chicken bites

3.6.1 Thiobarbituric acid

TBARS value was estimated as per the procedure given by Witte *et al.* (1970). Twenty grams of minced sample was blended with chilled 50 ml of 20% TCA for 2 minutes. The slurry was transferred to a 100 ml volumetric flask with 40 ml distilled water and the volume was made to 200 ml and filtered the filtered was named a TCA extract. A few ml of TCA extract was mixed with 2 ml of 0.1 % thiobarbituric acid heated for 30 minutes at 100°C and then cooled. The blank prepared was consisting of 5 ml distilled water and 5 ml of thiobarbituric acid reagent. The flasks were then cooled under tap water for 10 minutes and the optical density (O.D.) was recorded at 532 nm against blank. The TBARS value is mg of malonaldehyde per Kg of the sample.

3.6.2 Tyrosine value

The tyrosine value of chicken nuggets was estimated by the method described by Strange *et al.* (1977). A 20 g minced sample was blended with 50 ml chilled 20% trichloroacetic acid (TCA) for 2 minutes. Then the extract was obtained by filtering the content through Whatman filter paper No. 42. TCA extract 2.5 ml was diluted with 2.5 ml of distilled water. To this, 10 ml of 0.5 N NaOH was added. This mixture was kept for 10 min. Followed by the addition of 3 ml diluted Folin and Ciocalteu (FC) reagent (1 volume of FC reagent + 2 volumes of distilled water). After mixing, it was kept in a dark for 30 minutes at room temperature and absorbance was measured at 730 nm on a spectrophotometer (Pye systonics@ spectrophotometer 166).

For blank reading, a similar procedure was followed except using 2.5 ml TCA extract instant of 2.5 ml equal 10% TCA was added tyrosine value was calculated as mg /100 g sample by referring to a standard graph prepared as per the procedure of Pearson (1968).

3.7 Microbiological quality

At the end of storage, the microbiological quality of chicken bites was determined using the APHA method (1992), which included total plate count (TPC), yeast and mould count, and staphylococcus count.

Preparation of serial dilution:

Samples were prepared according to APHA (1992). Each sample was opened in an inoculation chamber of laminar flow (Model. RH-58-03. Science tech, India) pre-sterilized by ultra-violet (UV) radiation. 10 g of sample from this was aseptically weighed and transferred to a pre-sterilized mortar containing 90 ml of sterile 0.9% saline solution. The sample was homogenized using a sterile pestle for 2 min for uniform dispersion and to get a 10^{-1} dilution of the sample. To prepare 10^{-2} dilution, 1 ml of this diluted solution was quantitatively transferred and then mixed uniformly in a test tube containing 9 ml of sterile 0.9% saline solution. Similarly 1 ml of 10^{-2} dilution was added to 9 ml 0.9% sterile saline solution and mixed to obtain 10^{-3} dilution and so on. Preparations of sample and serial dilutions were done near flame in a horizontal laminar flow apparatus observing all possible aseptic conditions. Serial dilutions were made as per requirement.

3.7.1 Total plate count

The total Plate count was determined as per the procedure described in APHA (1992) using Nutrient agar. Nutrient agar (23.5 g) was dissolved in 1000 ml of distilled water in a flask and plugged with gauze cotton and autoclaved at 15 psi for 30 minutes and cooled to 45°C in a bacteriological water bath till it was used. One ml of each serial dilution of the sample was transferred aseptically to sterile petri plates in duplicate. The plates were then poured with 10-15 ml molten agar medium at 45°C . In order to ensure proper sample mixing, the petri plates were rotated 10-12 times each in clockwise-anticlockwise directions and up-down and allowed to set. After solidification, the Petri plates were incubated at 37°C for 24-36 hours. After incubation, the Petri plates containing 30-300 colonies were selected. The colonies were counted with the help of a colony counter. The average numbers of colonies were multiplied with a dilution factor to obtain the

total count as colony forming unit (cfu) per g of the sample. This count was then expressed as log cfu/g of the sample.

$$\text{CFU/gm of sample} = \frac{C}{(n_1 + 0.1 n_2) \times d}$$

C = Total number of colonies from all plates.

n₁ = number of plates of lower dilutions.

n₂ = number of plates of next to lower dilution.

d = dilution factor corresponding to the lower dilution.

3.7.2 Yeast and mould count

For yeast and mould count, potato dextrose agar was used and its pH was adjusted to 3.5±0.1 using tartaric acid as given in APHA (1992). Appropriate dilutions were taken in petri plates and the medium was transferred after solidification, the plates were incubated at 22°C for 2-3 days. The average number of colonies for dilutions was determined and the number of yeast and mould per gram of the sample was calculated. The average numbers of colonies were multiplied with dilution factor and expressed as yeast and mould count of log cfu/g of the sample.

3.7.3 Staphylococcus count

1-g sample in 10ml cooked meat medium (Difco) plus 9% NaCl (w/v), streaking a loopful of the 24 hour enrichment culture on Baird–Parker agar (Merck) containing egg yolk and potassium tellurite (Merck) and subsequent confirmatory coagulase test of lipase-positive jet-black colonies appeared on the plates were counted and expressed as log₁₀ cfu/g of sample.

3.8 Sensory evaluation

The sensory quality of chicken bites was evaluated by using 8 points descriptive scale (Keeton 1983) where 8 denoted extremely desirable and 1 denoted extremely poor. A sensory panel (semi-trained) of seven judges was requested to evaluate the product for different sensory attributes viz. appearance, flavour, juiciness, texture and overall acceptability.

3.9 Statistical analysis

The data collected during the study was analyzed using the analysis of variance technique by using software SPSS 20 test as described by Snedecor and Cochran(1994).



Results and Discussion



CHAPTER-IV

RESULTS AND DISCUSSION

The present study was planned with an objective to develop acceptable quality chicken bites with incorporation of whole wheat flour. Initially preliminary trial were conducted to determine chicken meat level in the formulation of bite. The main study was started with optimization of the whole wheat flour level (100%, 35%, 25%, 15%) in chicken bites and best variant was selected on the basis of sensory evaluation. Thereafter control along with best variant was selected from first experiment packed in LDPE pouches and kept at room temperature for assessment of shelf life. These stored samples were analyzed for quality parameter viz, physicochemical, microbiological and sensory quality till incipient spoilage at regular interval of 10 days during ambient storage.

The observations recorded during the study are presented under ensuing title:

- Effect of whole wheat flour on quality characteristics of chicken bites
- Shelf life of chicken bites stored at room temperature
- Cost structure of chicken bites

4.1 Effect of whole wheat flour on quality characteristics of chicken bites.

In this experiment whole wheat flour was added in the formulation of chicken bite at varying levels (100%, 35%, 25%,15%) by replacing equivalent amounts of chicken meat. The best combination of whole wheat flour and chicken meat was optimized on the basis of sensory evaluation. The abbreviations used during research are **C (control)**- bites with 100% whole wheat flour, **WF35** =Bites with 65% chicken meat and 35% whole wheat flour, **WF25** = Bites with 75% chicken meat and 25% whole wheat flour, **WF15** = Bites with 85% chicken meat and 15% whole wheat flour.

4.1.1 Sensory evaluation

The mean sensory scores for chicken bites added with different levels of wheat flour are presented in table 4.1.

From the study it is observed that addition of wheat flour in chicken bite formulation had significant ($P < 0.05$) effect on the scores of all sensory attributes. Sensory scores for all attributes were found significantly ($P < 0.05$) higher and lower in C and WF-15 respectively. However, there was no significant ($P > 0.05$) difference in colour and appearance as well as flavour score between WF35 and WF25. Lower colour and appearance score in treatment bites might be because of difference in the color of added chicken meat and substituting constituent wheat flour. Similar results were observed by Surender *et al.* (2011) for chicken meat mince enriched noodles. Contrarily, Singh *et al.* (2014) noted statistical significant ($P < 0.05$) increase in all sensory scores on replacement of rice flour as well as tapioca starch with refined wheat flour. Juiciness and texture scores were increased gradually with increase in the level of wheat flour addition in the chicken bite. WF35 had comparable juiciness and texture scores with C and W25, WF25 had comparable score with WF15. Gradual decrease in the texture and juiciness score in treatment bites might be due replacement of fiber containing wheat flour with high moisture rich containing raw lean meat. Similarly, Islam *et al.* (2018) observed increase in juiciness score with increased level of wheat flour in meatball. Gupta *et al.* (2015) also observed increase in juiciness score with increased level of oat meal in spent hen meat blocks. Contrarily Gamit *et al.* (2020) recorded decrease in juiciness with increase level of finger millet flour in chicken meat cutlets. Berwal *et al.* (2013) also noted decrease in texture score of cookies with increase in the level of chicken mince meat.

The overall acceptability score of control was found comparable with WF35 and WF25. It is obvious, as the sensory score of WF25 were at par with control and WF35, which may reflect on the overall acceptability score of the product. Present findings are in close agreement with Islam *et al.* (2018) who reported significant ($P < 0.05$) higher acceptance for wheat flour incorporated meatballs. Verma *et al.* (2014) also reported enhancement of sensory properties up to certain thresholds on addition of animal proteins in flour-based products. Considering sensory panelist's perspective for overall acceptability, addition of 25% wheat flour in chicken meat bites product is considered as optimal level.

Table 4.1 Sensory properties, physio-chemical and proximate composition of chicken bites incorporated with different levels of Wheat flour.

Parameters	C	Wheat flour (WF) levels		
		WF35	WF25	WF15
	Sensory evaluation [#]			
Color and appearance	7.33±0.19 ^a	6.66±0.19 ^b	6.33±0.19 ^b	5.33±0.19 ^c
Flavour	7.50±0.20 ^a	6.83±0.15 ^b	6.66±0.19 ^b	5.50±0.20 ^c
Juiciness	7.33±0.19 ^a	7.00±0.23 ^{ab}	6.66±0.19 ^{bc}	6.33±0.19 ^c
Texture	7.16±0.15 ^a	6.83±0.15 ^{ab}	6.50±0.20 ^{bc}	6.16±0.15 ^c
Overall acceptability	7.66±0.19 ^a	7.33±0.19 ^a	7.0±0.23 ^a	6.50±0.20 ^b
Physico-chemical attributes				
pH	6.52±0.07 ^a	5.90±0.009 ^b	5.78±0.005 ^c	5.72±0.005 ^c
Oil absorption (%)	36.43±0.17 ^a	30.76±0.29 ^b	29.92±0.48 ^b	28.09±0.37 ^c
Cooking Yield (%)	88.07±0.36 ^a	77.61±0.23 ^b	74.04±0.52 ^c	72.16±0.34 ^d
Proximate composition				
Moisture (%)	4.73±0.17 ^d	5.12±0.14 ^c	21.06±0.23 ^b	24.06±0.43 ^a
Protein (%)	10.75±0.18 ^d	16.06±0.18 ^c	18.68±0.39 ^b	22.42±0.59 ^a
Fat (%)	5.61±0.03 ^d	6.57±0.10 ^c	7.80±0.10 ^b	10.25±0.38 ^a
Ash (%)	1.27±0.06 ^c	1.65±0.09 ^b	1.86±0.02 ^b	2.17±0.08 ^a
Crude fiber (%)	2.49±0.11 ^a	1.83±0.02 ^b	1.07±0.01 ^c	0.85±0.03 ^d

Overall means bearing different superscripts in a row (a, b, c, d...) differ significantly (P<0.05)

4.1.2 Physico-chemical parameters

The observations with respect to physico-chemical properties of chicken bites added with different levels of wheat flour are presented in table 4.1.

The pH value of the bite was decreased with increase in the level of chicken meat in formulation. Control had significantly (P<0.05) higher pH value than treatments. However, there was no significant (P>0.05) difference in the pH value of WF 25 and WF15. Lower pH value in treatment than C might be attributed to the acidic nature of chicken meat than wheat flour (Kumar *et al.*

2016). Control had significantly ($P<0.05$) higher pH value than treatments as it is made with 100% whole wheat flour. Present findings are supported with result of Talukdar and Sharma (2010) who observed increase in pH value of emulsion and cooked chicken meat patties on incorporation of wheat flour. Similar results with present findings were reported by Verma *et al.* (2014) and Gupta *et al.* (2015) for wheat flour and oat meal added chicken meat noodles and spent hen meat blocks respectively.

Oil absorption value showed declining trend with increased level of chicken meat addition in bite formulation. The oil absorption value varied significantly ($P<0.05$) between C and treatment bites. C and WF-15 had significantly ($P<0.05$) higher and lower oil absorption values respectively than other treatments, but there was no significant ($P>0.05$) difference between 35% and 25% wheat flour containing chicken bites. The highest oil absorption in control bites (36.43%) might be due to oil absorbing property of the fiber available in the whole wheat flour (Habeebrakuman *et al.* 2019). Present findings are corroborated with the findings of Peska *et al.* (2010) for wheat fiber added fried extruded potato pellets. Tanna *et al.* (2020) recorded higher and lower oil absorption in rice flour and bengal gram flour added fish chakli than wheat flour added fish chakli.

Cooking yield (%) showed a declining trend with increase in the level of chicken meat in bite formulation. The highest cooking yield was noticed in control which was decreased at each level of incorporation of chicken meat in formulation of bite. Higher cooking yield in C is obvious due to water holding capacity of fibers available in whole wheat flour. Significant ($P<0.05$) lower cooking yield in all treatment bites is because of high moisture and less fibre content of chicken meat than whole wheat flour. Similarly, Singh *et al.* (2011) reported a decline in cooking yield as the meat level increased in chicken meat snacks. However, Singh *et al.* (2015) reported increases in cooking yield on addition of different fillers in chicken meat caruncles. The findings of the current study are comparable with result of Sharma and Nanda (2002) who reported lower cooking yield for chips made with 95% chicken meat than the formulations containing lower percentage of meat.

4.1.3 Proximate composition

Proximate compositions of chicken bites added with different levels of whole wheat flour are recorded in Table 4.1.

From the result, it is revealed that the moisture, protein and fat content of bites increased significantly ($p < 0.05$) at each level of inclusion of chicken meat in the formulation. The control bites had lowest moisture, protein and fat content than treatments. This might be due to less moisture, fat and protein content of whole wheat flour than chicken meat (Verma *et al.* 2014). These observations are in accordance with Gamit *et al.* (2020) and Chatli *et al.* (2015) for finger millet flour incorporated chicken meat cutlets and emu meat nuggets respectively. Gupta *et al.* (2015) also recorded similar declining trend for moisture, protein and fat percentage with increased level of oat meal in restructured spent hen meat blocks. However analogous findings with present study were reported by Kumar *et al.* (2010) as well as Chang and Carpenter (1997) for oat bran added chicken frankfurter and chevon patties respectively

Ash percentage was significantly ($P < 0.05$) higher in treated groups than control. In treatments, W15 bites had highest ash percentage, however, there was no significant ($P > 0.05$) difference in ash content of WF35 and WF25 bites. Higher ash content in treatment might be observed due to higher mineral content of chicken meat than wheat flour. Similar results were recorded by Eyidemir and Hayta (2009) for apricot kernel flour treated wheat flour noodles. Chin *et al.* (2012) also observed significant ($P < 0.05$) increase in ash content for surimi powder incorporated noodles. Present finding are in close agreement with Nawaz *et al.* (2019) who reported significant ($P < 0.05$) effect of addition of red fish meat on compositional parameter of wheat flours snack product

Crude fiber content showed declining trend in treatments bites. C had significantly ($P < 0.05$) higher crude fiber percentage, which was significantly ($P < 0.05$) decreased at each level of incorporation of chicken meat. Higher crude fibre content in C than treatment bites is due to higher fibre content of grains flours over animal food. Present findings are supported by observations of Verma *et al.* (2014) for whole wheat flour treated chicken meat noodles cutlets.

Similarly, Gamit *et al.* (2020) observed higher crude fiber content in finger millet flour treated chicken meat cutlets. Kumar *et al.* (2016) also recorded significantly ($P < 0.05$) higher crude fiber content in wheat bran added chicken meat biscuits. Result presented in present study shows that the quality parameters of WF25 resemble with C and WF35 Therefore WF25 was selected for further study.

4.2 Shelf life of chicken bites stored at room temperature

In this experiment, selected bites prepared using combination of 75% chicken meat and 25% whole wheat flour along with control bite containing 100% whole wheat flour were packed in low density polyethylene bags and stored at room temperature till incipient spoilage. The quality of stored product was evaluated at regular interval of 10 days. The abbreviations used during research are **C (control)**- bites with 100% whole wheat flour, **WF** - Bites with 75% chicken and 25% whole wheat flour.

4.2.1 Sensory properties

Mean sensory scores obtained during storage of control as well as 25% wheat flour and 75% chicken meat added bites at room temperature are presented in Table 4.2

Table 4.2 Storage related changes in sensory properties of chicken bites stored at room temperature

Treat/ Days	Day 0	Day10	Day 20	Day 30	Day 40
Colour and Appearance					
C	7.32±0.02 ^{Aa}	7.21±0.01 ^{Aa}	7.01±0.04 ^{Aab}	6.96±0.06 ^{Ab}	6.383±0.05 ^{Ac}
WF	6.91±0.01 ^{Ba}	6.61±0.01 ^{Bb}	6.24±0.02 ^{Bc}	5.83±0.01 ^{Bd}	5.38±0.01 ^{Be}
Flavor					
C	7.39±0.01 ^{Aa}	7.37±0.02 ^{Aa}	7.22±0.01 ^{Ab}	7.19±0.01 ^{Ab}	6.92±0.04 ^{Ac}
WF	7.03±0.02 ^{Ba}	6.68±0.01 ^{Bb}	6.17±0.01 ^{Bc}	5.69±0.02 ^{Bd}	4.86±0.02 ^{Be}
Texture					
C	7.14±0.01 ^{Aa}	7.11±0.02 ^{Aa}	7.03±0.01 ^{Aab}	6.993±0.02 ^{Ab}	6.695±0.02 ^{Ac}
WF	6.86±0.01 ^{Ba}	6.31±0.01 ^{Bb}	5.83±0.01 ^{Bc}	5.35±0.01 ^{Bd}	4.90±0.01 ^{Be}
Juiciness					
C	7.25±0.01 ^{Aa}	7.22±0.02 ^{Aa}	7.16±0.01 ^{Ab}	7.08±0.01 ^{Ac}	6.893±0.02 ^{Ad}
WF	6.85±0.01 ^{Ba}	6.12±0.02 ^{Bb}	5.63±0.01 ^{Bc}	5.16±0.02 ^{Bd}	4.41±0.03 ^{Be}
Overall Acceptability					
C	7.49±0.04 ^{Aa}	7.35±0.03 ^{Aab}	7.31±0.03 ^{Ab}	7.09±0.03 ^{Ac}	6.72±0.03 ^{Ad}
WF	7.11±0.04 ^{Ba}	6.73±0.09 ^{Bb}	6.36±0.04 ^{Bc}	5.79±0.09 ^{Bd}	5.05±0.03 ^{Be}

Overall means bearing different superscripts in a row (a, b, c, d...) differ significantly (P<0.05)

Overall means bearing different superscripts in a column (A, B, C, D..) differ significantly (P<0.05)

Sensory evaluation is of great significance for determining consumer acceptability and marketability of the product. The scores for all sensory attributes were found significantly (P<0.05) higher for C than WF throughout the storage period. However, these sensory score were decreased in C as well as WF with progression of storage period at room temperature. During storage, sensory study exhibited a non-significant (P>0.05) reduction in colour and appearance, texture as well as juiciness scores in C upto 20th days, thereafter these scores were declined significantly (P<0.05) on consequent day of analysis during 40th days of

storage. Scores for sensory attributes viz, colour and appearance, texture, juiciness shown similar declining pattern in C, however flavor score and overall acceptability decreased significantly ($P<0.05$) from 20th day onwards. The treated group containing 25% whole wheat flour exhibited significant ($P<0.05$) decrease in all sensory values through storage period. Decrease in sensory scores with progression of storage period might resulted due to breakdown of pigments, protein hydrolysis, oxidation of lipids and gradual loss of moisture in the chicken meat bites. Present findings are in agreement with Verma *et al.* (2015) and Islam *et al.* (2018) for replacement of wheat flour with chicken meat in noodles and chicken meatball respectively. Kapse (2016) also reported similar declining trend in flavor score during storage of chevon noodles at room temperature. However, on 50th days storage, product exhibited sign of incipient spoilage such as foul smell, sliminess and rejected by sensory panelists. Therefore the stored product were not evaluated for any quality parameter.

4.2.2 Physico-chemical characteristics

Mean values for changes in physico-chemical properties of chicken bites stored at room temperature are presented in Table 4.3

The results presented in the study represents significantly ($P<0.05$) higher moisture content in WF than C throughout the storage period, as chicken meat contains higher moisture content than the dried wheat flour. During storage, moisture percentage was decreased over the 40-day period, which was declined gradually upto 40th day and 20th day of storage in C and WF respectively. There after it was decreased significantly ($P<0.05$) in both product with subsequent storage. A possible cause for the decrease in moisture content could be evaporation of moisture from bites stored in aerobic packaging at room temperature. Higher moisture loss in WF on 20th of storage onwards might be due to availability of nutrient rich chicken meat to microbes in the bite formulation, which ultimately increases activity and proliferation of microbes. Similar observation for moisture content was reported by More *et al.* (2019) during storage of quail meat enriched wheat flour based noodles at room temperature ($35\pm 2^{\circ}\text{C}$). Singh *et al.* (2011) also reported similar values for vacuum packed

chicken snacks stored at room temperature.

Table 4.3 Storage related changes in physico-chemical characteristics of chicken bites stored at room temperature.

Treat/ Days	Day 0	Day 10	Day 20	Day 30	Day 40
	Moisture (%)				
C	4.61±0.01 ^{Ba}	4.55±0.02 ^{Ba}	4.48±0.01 ^{Bab}	4.40±0.01 ^{Bab}	4.31±0.02 ^{Bb}
WF	20.11±0.01 ^{Aa}	19.15±0.02 ^{Aab}	18.84±0.01 ^{Aab}	16.83±0.01 ^{Abc}	15.01±0.02 ^{Ac}
	pH				
C	6.09±0.02 ^{Ab}	6.14±0.04 ^{Ab}	6.29±0.05 ^{Ab}	6.58±0.11 ^{Aa}	6.72±0.12 ^{Aa}
WF	5.56±0.06 ^{Bd}	5.67±0.02 ^{Bcd}	5.78±0.01 ^{Bbc}	5.87±0.02 ^{Bb}	5.99±0.02 ^{Ba}
	Thiobarbituric acid (mg malonaldehyde /kg)				
C	0.45±0.01 ^{Bd}	0.47±0.01 ^{Bd}	0.63±0.02 ^{Bc}	0.76±0.02 ^{Bb}	0.82±0.01 ^{Ba}
WF	0.60±0.01 ^{Ad}	0.61±0.01 ^{Ad}	0.67±0.01 ^{Ac}	0.82±0.02 ^{Ab}	0.91±0.01 ^{Aa}
	Tyrosine value (mg/kg)				
C	0.25±0.02 ^{Bc}	0.26±0.01 ^{Bc}	0.28±0.01 ^{Bc}	0.36±0.01 ^{Bb}	0.53±0.01 ^{Ba}
WF	0.65±0.01 ^{Ad}	0.68±0.01 ^{Ad}	0.77±0.02 ^{Ac}	0.89±0.03 ^{Ab}	1.03±0.02 ^{Aa}

Overall means bearing different superscripts in a row (a, b, c, d...) differ significantly (P<0.05)

Overall means bearing different superscripts in a column (A, B, C, D..) differ significantly (P<0.05)

From table 4.3 it is clear that the C had significantly (P<0.05) higher pH value than WF throughout storage period. Higher pH value in C than WF could be attributed to the absence of chicken in formulation, which is known to have an acidic nature. During storage study, there was no significant change in pH value of C upto 20th day as well as between 30th and 40th day. However, irrespective of treatment, pH value increased with progression of storage period. This can occur due to formation of basic nature having non-protein compounds and ammonium ions in the stored products. Present findings are compared with result reported by Singh *et al.* (2011) for chicken snacks stored at ambient temperature. Similar observation were noted by Kumar *et al.* (2016) during storage of chicken meat

biscuits at ambient temperature

Thiobarbituric acid reactive substances (TBARS) are commonly used to assess lipid per oxidation, it is measured in term of malondialdehyde (MDA) and expressed as milligrams per kilogram (mg/kg). However, tyrosine value represents the breakdown of protein available in the food product during storage.

Data presented in Table 4.3 showed higher TBARS and tyrosine value for WF than C throughout storage period, obvious reason behind this is the oxidation of unsaturated fatty acid and protein present in added nutrient rich chicken meat. During storage, TBARS values showed similar increasing trend in C as well as WF product with progression of storage period. The significant ($P<0.05$) increase in TBARS value might occur due to the use of vegetable oil for frying during preparation of both bites. Primary increase in TBARS value in both stored products attributes to the development of volatile compounds, which is formed due to consequence of the oxidation process. Subsequent increase in TBARS value may also influenced by the oxygen permeability of packaging material used during storage. Similar observation reported by Berwal *et al.* (2013) for aerobically packed chicken mince meat incorporated cookies stored at ambient temperature.

Tyrosine value of C increased gradually upto 20th day of storage thereafter it was increased significantly ($P<0.05$) on subsequent day of storage. Lower protein content of the wheat flour may be a reason behind gradual increase in tyrosine value of C. However, tyrosine value of WF increased significantly ($P<0.05$) with advancement of storage period. Increase in tyrosine value during storage might observed because of release of amino acid on breakdowns of chicken proteins by microbial action. Results of the present study are in close agreement with More *et al.* (2019) for quail meat enriched wheat flour-based noodles stored at room temperature ($35\pm^{\circ}\text{C}$).

4.2.3 Microbiological quality

Storage related changes in microbial quality of chicken bites added with wheat flour at room temperature are presented in Table 4.4.

Table 4.4 Storage related changes in microbiological quality of chicken bites stored at room temperature

Treat/ Days	Day 0	Day 10	Day20	Day30	Day40
	Total plate count (log₁₀cfu/g)				
C	1.02±0.07 ^c	2.02±0.06 ^{Bd}	3.79±0.03 ^c	4.12±0.01 ^{Bb}	5.56±0.01 ^{Ba}
WF	1.22±0.05 ^c	2.43±0.04 ^{Ad}	3.84±0.01 ^c	4.47±0.02 ^{Ab}	6.88±0.11 ^{Aa}
	Yeast and Mould count (log₁₀ cfu/g)				
C	ND	ND	ND	0.67±0.02 ^{Bb}	1.40±0.03 ^{Ba}
WF	ND	ND	ND	1.31±0.05 ^{Ab}	2.00±0.01 ^{Aa}
	Staphylococcus count(log₁₀cfu/g)				
C	ND	ND	ND	ND	0.95±0.08 ^{Ba}
WF	ND	ND	ND	ND	1.36±0.04 ^{Aa}

Overall means bearing different superscripts in a row (a, b, c, d...) differ significantly (P<0.05)

Overall means bearing different superscripts in a column (A, B, C, D...) differ significantly (P<0.05)

Result showed higher total plate count (TPC) for chicken meat bites prepared using combination of 75% chicken meat and 25% whole wheat flour compared to the control bites. However, TPC was found significantly (P<0.05) lower in C than WF on 10, 30 and 40th day of the storage at room temperature. This disparity in TPC values of C and WF could be due to the inherently greater nutritive value of meat in comparison to flour. Singh *et al.* (2011) also recorded similar findings for vacuum packed chicken snacks stored at room temperature. Furthermore, total plate count was found to be increased significantly (P<0.05) in both products during entire duration of storage at room temperature. These findings aligned with the results obtained by More *et al.* (2019) who observed a

consistent rise in total plate count in quail meat enriched noodles as storage period progressed.

It is evident from the data provided in Table 4.4 that the yeast and mould count remained absent in both stored bites upto the 20th day of storage. Thereafter there was a significant ($P<0.05$) increase in the count ($P<0.05$) as the storage period extended to 40 days. The chicken bites containing 25% whole wheat flour exhibited significantly ($P<0.05$) higher yeast and mould counts compared to the control bites. This might be due to higher moisture content of the WF, which creates ideal conditions for growth of yeast and mould at room temperature. Present findings are supported with the result recorded by Nemade *et al.* (2021) for cookies incorporated with spent hen meat stored at ambient temperature. Bhumre (2018) also reported an increase in yeast and mould counts for chicken eggs enriched wheat flour noodles with the progression of storage days.

During the microbial study, Staphylococcus count was not detected both in C and WF up to 30th day of storage at room temperature. While, on at the end of storage period, 0.95 log cfu/g and 1.36 ± 0.04 count was detected in C and WF respectively. A statistical analysis revealed higher Staphylococcus count for WF than C, as nutrients rich chicken meat is present in the WF formulation, which may facilitate growth and proliferation of Staphylococcus during storage. Initial absence of Staphylococcus count in both stored products might attribute to the hygienic processing conditions followed at proper time and temperature. These findings are in accordance with Jairath *et al.* (2014) for enrobed goat meat bites under aerobic packaging at $4\pm1^{\circ}\text{C}$.

4.3 Cost structure of chicken bites

Cost of production C (100% whole wheat flour bite) and WF (25% wheat flour bite) are presented in Table 4.5.

The production cost of C and WF was calculated by taking into account market rates of raw material used in bites formulation. The cost of production for 1 kg C bite is Rs. 113.71, while it is Rs. 240.51 for WF. Statistical analysis of data derived during the study with respect to cost exhibited higher production cost for WF than C. It is very obvious as 75% of high priced chicken meat was added in

formulation by replacing low cost whole wheat flour used in C. Similar findings were documented by More *et al.* (2019) during product cost estimation of value-added wheat flour-based noodles using quail minced meat.

Table 4.5 Cost structure of chicken bites

Sr.No	Particulars	Market price /kg (Rs)	C		WF	
			Qty.(g)	Cost (Rs)	Qty.(g)	Cost (Rs)
1	Deboned chicken meat	300/kg	00	00	506.25	151.87
2	Wheat flour	50/kg	675	33.75	168.75	8.43
3	Corn starch	400/kg	40	16	40	16
4	Condiments	250/kg	30	7.5	30	7.5
5	Salt	20/kg	15	0.3	15	0.3
6	Oil	200/kg	80	16	80	16
7	Spices	400/kg	50	20	50	20
8	Ajwain	320/kg	25	8	25	8
9	Baking soda	82/kg	05	0.41	5	0.41
10	Cold water	----	80	----	80	-----
11	LDPE pouch for1 kg 200gm/pack)	0.4/pack	05	2	05	2
12	Fuel and labour charges	10/kg	-----	10	-----	10
13	Product yield (gm)		1000gm		1000gm	
14	Cost of production/Kg (Rs)		113.96		240.51	

C- bites with 100% whole wheat flour, WF-bites with 25% whole wheat flour and 75% chicken meat.



Summary and Conclusions



CHAPTER-V

SUMMARY AND CONCLUSION

Snacks products are becoming very popular recently, which are generally made up of cereals. Bite is a fat fried snack product generally made from carbohydrate rich refined wheat flour. While consumers are demanding for healthy nutritious snack products. Addition of chicken meat in snack product is best choice for development of nutrient rich snack product at affordable price. Its use in snack product also creates a new avenue for profitable chicken utilisation, which improve people's nutritional status as well as profitability of chicken industry. Even though extensive research has been conducted to improve the qualities and nutritional characteristics of snack products through formulation change, the option of including chicken flesh in bites as a source of protein remains untapped. Therefore snack sector aims to meet consumer demand for healthier, low carbohydrate, high-protein snacks with longer shelf life. Thus, the current study's goal is to determine the optimal wheat flour and chicken meat ratio for development of acceptable quality chicken bite as well as to assess its shelf life at room temperature for till incipient spoilage in LDPE pouches.

Meat snacks have a crispy texture, brittleness appealing shape and colour, and a hot and spicy flavour. The crispy texture of meat snack product is crucial parameter for product perception. In this study, chicken bites were made by combining different level of minced meat (0%, 35%, 25% and 15%) with non-meat ingredients such as vegetable oil, corn starch, spices, wheat flours. The acceptability of these bites was evaluated on the basis of sensory, physicochemical and proximate composition evaluation. The selected samples were packed and stored at room temperature for quality analysis at regular interval of 10 day upto incipient spoilage.

5.1 Effect of incorporation of wheat flour on quality of chicken bites

In the first experiment, different levels (100, 35, 25 and 15%) of wheat flour were added in chicken bite. Acceptable quality chicken bites were selected on the basis of sensory evaluation. Replacement of chicken meat with wheat flour

exhibited significant ($P<0.05$) effect on scores of all sensory parameters. Control bites had significantly ($P<0.05$) higher sensory scores for all attributes than treatment bites. However, WF 25 had comparable sensory scores with C and WF35. Mean values for pH, oil absorption, cooking yield and crude fibre content were significantly ($P<0.05$) lower, while moisture, fat, ash and protein content significantly ($P<0.05$) higher in treatment bites than C. Based on the above findings, considering the sensory perception of consumers for overall acceptability of WF25, it was selected for storage study.

5.2 Shelf life of chicken bites during room temperature storage

The shelf life of chicken bites combined with whole wheat flours was investigated by a regular interval of 10 days at room temperature till incipient spoilage. Control bites had significantly ($P<0.05$) higher sensory scores, moisture content and pH value, while lower TBA, tyrosine values and microbial count than WF throughout the storage period. Mean values for sensory scores, moisture content and pH value decreased significantly ($P<0.05$), while values for TBA, tyrosine and microbial count increased significantly ($P<0.05$) in both C and WF with progression of storage period at room temperature. The count for yeast and mould was detected 30th day onwards at room temperature in C as well as WF. Similarly, Staphylococcus count was obtained on 40th of storage in both the stored products. While on 50th day of storage, WF exhibited signs of incipient spoilage such as foul smell, sliminess, since on 50th stored samples were not subjected to quality analysis.

5.3 Cost structure of chicken bites

The market cost of raw materials was considered to determine the product cost. The expenditure of Rs. 113.71 was incurred towards production of 1 kg C, while Rs. 240.51 was incurred towards production of WF. The amount required for production of WF bites was higher than C.

CONCLUSIONS

- Addition of 25% whole wheat flour were found optimum for preparation of acceptable quality chicken bites.
- Nutrient rich bites could be produced by replacing 75% whole wheat flour with similar amount of chicken meat to cater the consumer demand.
- Bites made with wheat flour as well as 75% chicken meat and 25% wheat flour could be stored at room temperature for 40 days.
- Production cost for chicken bites containing 25% whole wheat flour and 75% chicken meat was higher than whole wheat flour bites.



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Appendix



DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

College of Veterinary and Animal Sciences, Parbhani

Proforma for Organoleptic Evaluation of Meat Products

Name of Evaluator :

Date:

Name of Product : Chicken Bites

Sensory attributes	8-point scale for descriptive attributes of product							
	8	7	6	5	4	3	2	1
Colour and Appearance	Excellent	V. good	Good	Fair	Sli. Poor	Mod. Poor	V. Poor	Extr. poor
Flavour	Extremely desirable	V. desirable	Mod. desirable	Sli. desirable	Sli. undesirable	Mod. undesirable	V. undesirable	Extr. undesirable
Texture	Extremely desirable	V. desirable	Mod. desirable	Sli. desirable	Sli. undesirable	Mod. undesirable	V. undesirable	Extr. undesirable
Juiciness	Extremely juicy	V. juicy	Mod. juicy	Sli. juicy	Sli. dry	Mod. dry	V. dry	Extr. dry
Overall palatability	Extremely palatable	V. palatable	Mod. palatable	Sli. palatable	Sli. unpalatable	Mod. unpalatable	V. unpalatable	Extr. unpalatable

Sample	Colour & Appearance	Flavour	Juiciness	Texture	Overall acceptability
A					
B					
C					
D					

Remarks:

Signature



Vitae

VITAE

The author Mr. Aher Shivaji Dattrao born on 5th February 1997, at. Nalegaon , Tal. Aundha (Na.) District. Hingoli (Maharashtra State).

He passed the S.S.C examination in 2013 from Bhartiya Balvidya Mandir Parbhani and H.S.C. board exam in 2015 from Yeshwant Mahavidyalaya, Nanded.

He is striving for the better future opportunities in the field of Veterinary and Animal Husbandry. As he has keen interest affection for animals, he joined College of Veterinary and Animal Sciences, Parbhani in 2016 and completed the B.V.Sc & A.H degree in 2022. Further he joined M.V.Sc degree course in the discipline of Livestock Products Technology at College of Veterinary and Animal Sciences, Parbhani, MAFSU in the year 2022. He actively completed 21 days In-plant training programme at Reliable Agro Foods Gut. No. 160/161, Purna Dist. Parbhani 431511.

The author has completed the necessary credit courses for postgraduate studies and submitted this thesis in the year 2024. He completed three days online training on the “State Level Certification Programme for Abattoir Veterinarians”. He participated in the DST SERB funded National Symposium on "One Health for a Pandemic-free Future". He also participated in National Symposium on “Animal Genetic Resources (AnGR) Management for Rural Livelihood Enhancement” & XX Annual Convention of Society for Conservation of Domestic Animal Biodiversity. He actively participated in National Service Scheme (NSS) unit during graduate studies.



Thesis Abstract



APPENDIX-G
THESIS ABSTRACT

- a) Title of the thesis : **QUALITY CHARACTERISTICS OF CHICKEN BITES ENRICHED WITH WHEAT FLOUR**
- b) Full name of student : **Aher Shivaji Dattrao**
- c) Name and address of : **(Dr. A. M. Chappalwar)**
Major Advisor Advisor/Guide
Assistant Professor
Livestock Products Technology
- d) Degree to be awarded : **M.V.Sc.**
- e) Year of award of : **2024**
degree
- f) Major subject : **Livestock Products Technology**
- g) Total number of pages : **45**
in the thesis
- h) Number of words in the : **235**
abstract
- i) Signature of Student :
- j) Signature, Name and :
address of forwarding
authority (HOD/SH)

Dr. A. M. Chappalwar
Incharge Professor
Dept. of Livestock product Technology.

ABSTRACT

The present study was undertaken to ascertain the optimal proportion of chicken meat to flour for the production of chicken bites, as well as to ascertain the duration for which they can be stored in LDPE packaging at ambient temperature. The chicken bites were prepared by combining chicken meat with non-meat constituents, such as vegetable oil, corn starch, spices and varying quantities of wheat flour (Control -100%, treatments- 35%, 25%, and 15%). The level of addition of wheat flour in chicken bites was determined based on sensory, physicochemical, and proximate composition analysis. Present study showed that the addition of chicken meat led to a gradual and significant decrease in all quality parameter except moisture, protein fat and ash content. However, panelists showed acceptability upto 25% addition of whole wheat flour in chicken bite. Quality assessment of LDPE packed selected chicken bites containing 25% whole wheat flour along with a control was performed at room temperature after every 10 days. Result shows that significant ($P<0.05$) higher physicochemical parameters as well as microbial count while significant ($P<0.05$) lower sensory scores for treatment bite than control which were decreased significantly ($P<0.05$) in both stored products. Higher cost was required for production of treatment bite than control bite. From the study, it is concluded that the acceptable quality chicken bites could be produced with addition of 25% wheat flour, which could be stored for 40 days at ambient temperature.

परिशिष्ट-जी

प्रबंधाचा सारांश

- १) प्रबंधाचे नाव : गव्हाच्या पिठाणे समृद्ध केलेल्या चिकन बाईटची गुणवत्तापूर्ण वैशिष्टे
- २) विद्यार्थ्याचे संपूर्ण नाव : आहरे शिवाजी दत्तराव
- ३) मार्गदर्शक : डॉ. अ. मा. चप्पलवार
सहाय्यक प्राध्यापक, पशूजन्य पदार्थ प्रक्रिया
तंत्रज्ञान विभाग , पशुवैद्यक व पशुविद्यान
महाविद्यालय,परभणी.
- ४) पदवी : एम.व्ही.एस.सी.
- ५) पदवी प्रदान करण्याचे वर्ष : २०२४
- ६) मुख्य विषय : पशूजन्य पदार्थप्रक्रिया तंत्रज्ञान विभाग
- ७) प्रबंधाची एकूण पाने : ४५
- ८) सारांशाचे एकूण शब्द : २२७
- ९) विद्यार्थ्याची स्वाक्षरी :
- १०) अग्रेषण अधिकार्याची सही, :
नाव व पत्ता (विभागप्रमुख)

डॉ. अ. मा. चप्पलवार

सहाय्यक प्राध्यापक,

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सारांश

प्रबंधाचे शीर्षक : गव्हाच्या पिठाणे समृद्ध केलेल्या चिकन बाईटची गुणवत्तापूर्ण वैशिष्टे

हा अभ्यास चिकन बाईटच्या उत्पादनासाठी कोंबडीच्या मांसाचे आणि गव्हाच्या पिठाचे प्रमाण तपासण्यासाठी तसेच खोलीच्या तापमानात हवाबंद (ल. डी. पी. ई.) पॅकेजिंगमध्ये ते किती कालावधीसाठी साठवले जाऊ शकतात हे तपासण्यासाठी केला गेला. चिकन बाईट हे कोंबडीचे मांस, तसेच वनस्पती तेल, कॉर्न स्टार्च, मसाले आणि वेगवेगळ्या प्रमाणात गव्हाचे पीठ (नियंत्रण - १०० %, उपचार - ३५%, २५% आणि १५%) एकत्र करून तयार केले गेले. चिकन बाईट मध्ये गव्हाच्या पिठाची मात्रा संवेदी इंद्रियाचा वापर करून निर्धारित केले गेलेले आहे. सध्याच्या अभ्यासातून असे दिसून आले की, कोंबडीचे मांस टाकल्यामुळे पाणी, प्रथिने चरबी आणि राख सामग्री वगळता सर्व गुणवत्तेच्या पॅरामीटरमध्ये हळूहळू आणि लक्षणीय घट झाली. तथापि, चिकन बाईट मध्ये २५ % पर्यंत गव्हाचे पीठ टाकून खाण्यायोग्य चिकन बाईट बनवता येते. चिकन बाईट व गव्हाचे बाईट ल. डी. पी. ई. मध्ये पॅक करून रूमच्या तापमानाला खराब होई पर्यंत साठवून ठेवून या दरम्यान १० दिवसांच्या अंतराने या पदार्थाची गुणवत्ता तपासली गेली आहे. चिकन बाईट मध्ये गव्हाच्या पिठाच्या बाईटच्या तुलनेत टीबीए, टायरोसिन तसेच सूक्ष्मजंतु (पूर्ण प्लेटमधील सूक्ष्मजंतूंची संख्या, यीस्ट आणि मौल्ड आणि स्टाफेनोकोकस) चे प्रमाण जास्त आढळून आले होते. साठवण दरम्यान दोन्ही साठवलेल्या पदार्थात भौतिक रासायनिक गुणधर्मात तसेच सूक्ष्मजीवांच्या संख्येत वाढ झालेली आढळून आली तर संवेदी स्कोर मध्ये घाट झालेली आढळून आले. चिकन बाईटच्या उत्पादनासाठी गव्हाच्या बाईटच्या तुलनेत जास्त खर्च झाला. या अभ्यासातून, असा निष्कर्ष काढण्यात आला आहे की स्वीकार्य दर्जाचे चिकन बाईट २५ % गव्हाचे पीठ टाकून तयार करू शकतो, हे चिकन बाईट खोलीच्या तापमानात ४० दिवसांपर्यंत साठवून ठेऊ शकतो.