

**SENSORY CHARECTERISTICS AND PHYSIOCHEMICAL PROPERTIES
OF BREAD WITH PUMPKIN PULP (*Cucurbita moschata*) AS PARTIAL
REPLACER OF WHEAT FLOUR**

A THESIS

BY

MOST. SHAMMI AKTER

Student ID: 1707031

Registration No: 1707031

Session: 2023-2024

Semester: January – June, 2024

MASTER OF SCIENCE

IN

FOOD PROCESSING AND PRESERVATION



DEPARTMENT OF FOOD PROCESSING AND PRESERVATION

**HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY,
DINAJPUR**

JUNE, 2024

**SENSORY CHARECTERISTICS AND PHYSIOCHEMICAL PROPERTIES
OF BREAD WITH PUMPKIN PULP (*Cucurbita moschata*) AS PARTIAL
REPLACER OF WHEAT FLOUR**

A THESIS

BY

MOST. SHAMMI AKTER

Student ID: 1707031

Registration No: 1707031

Session: 2023-2024

Semester: January – June, 2024

Submitted to the

Department of Food Processing and Preservation

In partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

IN

FOOD PROCESSING AND PRESERVATION



**DEPARTMENT OF FOOD PROCESSING AND PRESERVATION
HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY
UNIVERSITY, DINAJPUR**

JUNE, 2024

**SENSORY CHARECTERISTICS AND PHYSIOCHEMICAL PROPERTIES
OF BREAD WITH PUMPKIN PULP (*Cucurbita moschata*) AS PARTIAL
REPLACER OF WHEAT FLOUR**

A THESIS

BY

MOST. SHAMMI AKTER

Student ID: 1707031

Registration No: 1707031

Session: 2023-2024

Semester: January – June, 2024

Approved as to the Style and Content By

.....
Supervisor
Md. Mojaffor Hosain
Associate Professor

.....
Co-Supervisor
Dr. S.M Kamrul Hasan
Professor

.....
Dr. S.M Kamrul Hasan
Chairman of the examination committee and Chairman

**HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY
UNIVERSITY, DINAJPUR**

JUNE, 2024

DEDICATED

TO

MY BELOVED PARENTS

ACKNOWLEDGEMENT

All praises and admirations are solely due to the Almighty Allah for blessing the author with the strength, aptitude, and patience that enabled her to pursue her education and complete this thesis work for the degree of Masters of Science (MS) in Food Processing and Preservation, under the Faculty of Engineering.

*The author has immense pleasure to express her sincere appreciations and deep sense of profound indebtedness to her major advisor and research supervisor, **Md. Mojaffor Hosain**, Associate Professor, Department of Food Processing and Preservation, Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, for his guidance and moral support. His constant support, valuable suggestions, useful criticisms, and encouragement enabled the author to overcome all hardships throughout the period of completion of this research work as well as reviewing this manuscript.*

*The author humbly desires to express her regard and deepest gratitude to her Co- Supervisor, **Professor Dr. S.M Kamrul Hasan**, Department of Food Processing and Preservation, for her critical advice and valuable comments, as well as constructive criticisms, during the research period and in the preparation of the dissertation.*

*The author is also indebted to Professor and Chairman **Dr. S.M Kamrul Hasan**, Department of Food Processing and Preservation, HSTU, Dinajpur, who directly or indirectly help me to complete this work,*

The author is also very grateful and indebted to all the laboratory and office staff of the Department of Food Processing and Preservation, HSTU, Dinajpur, who directly or indirectly helped me to complete this work,

Last but not least, the author is truly obliged to express her heartfelt gratitude to her beloved parents, family members, friends, seniors, and juniors who always sacrificed and gave all sorts of support, which caused happiness for her study and constant inspiration throughout her academic career.

Finally, the financial support of the study provided by the Ministry of National Science and Technology, Government of the People's Republic of Bangladesh is gratefully acknowledged.

The Author

ABSTRACT

Consumer acceptability and physico-chemical properties of prepared pumpkin bread were evaluated in an effort to increase consumption of the vegetable. This study was conducted with a view to explore some ways to use pumpkin vegetable in the form of bread. Using three different levels (0%, 5%, and 7%) of pumpkin flour and steam pumpkin pulp for making bread and analyzed the physico-chemical, bioactive compounds, antioxidant activity, and sensory characteristics. The amount of pumpkin flour and steam pumpkin pulp added to the bread was found to affect the bread quality significantly ($p < 0.05$). The study showed high values of loaf volume ($410.75 \pm 1.25 \text{ cm}^3$) and specific volume ($2.69 \pm 0.20 \text{ cm}^3/\text{g}$) at control bread. There were distinctive color changes with the addition of the pumpkin flour and steam pumpkin pulp: 'L' values were reduced, but 'a' and 'b' values were significantly increased ($p < 0.05$). Pumpkin bread contained moisture (22.57-25.92%), ash (1.69-1.93), fat (3.26-4.92), crude fiber (0.33-0.59%), carbohydrate (59.93-62.75%) content. However, there was a significant decreased ($p < 0.05$) in protein content (8.87-6.94%) for which flour and pulp. The bioactive compounds (phenol, flavonoid, beta-carotene, and total carotenoids) and antioxidant activity were significantly increased with an increase in the level of pumpkin flour and steam pumpkin pulp. The highest amount of total phenolics (10.48 mg/100 g), flavonoids (3.03 mg/100 g), and DPPH free radical scavenging activity (251.43 $\mu\text{mole}/100 \text{ g}$) was found in bread with a 7% replacement of pumpkin flour. Pumpkin flour exhibited the highest amount of total carotenoid contents (30.50 $\mu\text{g}/100 \text{ g}$) and β -carotene (5.32 mg/100 g). Statistically analysis of sensory attributes ($P < 0.05$) revealed that sample 2 (prepared by 5% pumpkin flour) was most delicious and appreciated among other samples. Almost all samples had good sensory acceptance in terms of color, texture, taste and overall acceptability.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	ACKNOWLEDGEMENTS	i
	ABSTRACT	ii
	CONTENTS	iii-vi
	LIST OF TABLES	vii
	LIST OF FIGURES	viii
	LIST OF ABBREVIATION	ix
CHAPTER I	INTRODUCTION	1-2
CHAPTER II	REVIEW OF LITERATURE	3-12
2.1	Bread	3
2.2	Pumpkin	3
2.2.1	History of Pumpkin	3
2.3	Varieties of Pumpkin	4
2.4	Production of Pumpkin	4
2.5	Production of Pumpkin in Bangladesh	5
2.6	The Importance of Value-Added Products in Reducing Post-Harvest Losses	5
2.7	Compositions of Pumpkin	6
2.8	Utilization of Pumpkin	7
2.8.1	General utilization of Pumpkin	7
2.8.2	Weaning Properties of Pumpkin	8
2.9	Medical Properties of Pumpkin	8
2.10	Drying Techniques for Pumpkin	9
2.11	Some others researches on Pumpkin	10

TABLE OF CONTENTS (Contd.)

CHAPTER	TITLE	PAGE
CHAPTER III	MATERIALS AND METHODS	13-23
3.1	Experimental Site	13
3.2	Sample Collection	13
3.3	Equipments	13
3.4	Reagents	14
3.5	Sample and product preparation procedure	14
3.5.1	Preparation of Raw Pumpkin Powder	14
3.5.2	Preparation of Steam Pumpkin Pulp	15
3.5.3	Preparation of Bread	15
3.6	Determination of Physical Properties of the Bread	16
3.6.1	Bread Weight	16
3.6.2	Loaf Height, Length and Breadth	16
3.6.3	Loaf Volume and specific volume	17
3.6.4	Density	17
3.6.5	Crum Firmness	17
3.6.6	Assessment of Colouring	17
3.6.7	Determination of Crust- Crum Ratio	17
3.7	Proximate Analysis	18
3.7.1	Determination of Moisture Content	18
3.7.2	Determination of Ash	18
3.7.3	Determination of Fat	19
3.7.4	Determination of Protein	20
3.7.5	Determination of Total Carbohydrate	21
3.7.6	Determination of Fiber	22
3.8	Determination of Total Carotenoids Content	22
3.9	Determination of β -carotene	22
3.10	Determination of Total Phenol Content	22

TABLE OF CONTENTS (Contd.)

CHAPTER	TITLE	PAGE
3.11	Determination of Flavonoid Content	23
3.12	DPPH radical scavenging capacity	23
3.13	Sensory Evaluation of Bread	23
3.14	Statistical analysis	24
CHAPTER-IV	RESULTS & DISCUSSIONS	25-36
4.1	Physical Properties of Bread	25
4.1.1	Weight of Bread	26
4.1.2	Volume of Bread	26
4.1.3	Specific Volume of Bread	26
4.1.4	Density of Bread	27
4.1.5	Crust- Crum Ratio of Bread	27
4.1.6	Firmness of Bread	27
4.2	Crust and Crum colour of Bread samples	27
4.3	Proximate Composition of Bread Samples	29
4.3.1	Moisture content	29
4.3.2	Ash Content	29
4.3.3	Fiber Content	30
4.3.4	Crude protein	30
4.3.5	Fat Content	30
4.3.6	Carbohydrate	30
4.4	Bioactive compounds and Antioxidants activities of Bread Samples	31
4.4.1	Total Phenol Content of Bread Samples	32
4.4.2	Total Flavonoid Content of Bread Samples	32
4.4.3	Antioxidant Activity (DPPH) of Bread Samples	33
4.4.4	Beta Carotene content of Bread Samples	33
4.4.5	Total Carotenoid contents	34
4.6	Sensory Evaluation Score	34

TABLE OF CONTENTS (Contd.)

CHAPTER	TITLE	PAGE
CHAPTER-V	SUMMARY AND CONCLUSION	37-38
	REFERENCES	39-47

LIST OF THE TABLES

TABLE NO	TITLE	PAGE
2.1	Varieties of Pumpkin	4
2.2	Top 10 World Producers of Pumpkins, Squash and gourds, Ranked by Production (FAOSTAT 2016)	5
2.3	Nutrient composition of pumpkin pulp powder	6
3.1	Incorporation of flour at different levels (per 100gm)	15
3.2	Ingredient amount for dough preparation (per 100 gm of flour)	16
4.1	Physical properties of bread incorporate with different level of pumpkin flour and steam pumpkin pulp	25
4.2	Means crust and crumb colour of bread incorporate with different level of pumpkin flour and steam pumpkin pulp	28
4.3	Proximate composition (%) of bread incorporate with different level of pumpkin flour and steam pumpkin pulp	29
4.4	Bioactive Compounds and Antioxidants Activity of bread incorporate with different level of pumpkin flour and steam pumpkin pulp	31
4.5	Sensory Evaluation of bread incorporate with different level of pumpkin flour and steam pumpkin pulp	35

LIST OF THE FIGURES

FIGURE NO	TITLE	PAGE
3.1	Freshly collected pumpkin	13
3.2	Flow chart of preparing of pumpkin flour	14
3.3	Photographic view of raw pumpkin	15
3.4	Photographic view of pumpkin before drying	15
3.5	Photographic view of pumpkin flour	15
3.6	Flow chart of preparation of steam pumpkin pulp	15
3.7	Photographic view of prepared bread samples	16
4.1	Graphical representation of sensory attributes (color, texture, taste, flavor and overall acceptance)	36

ABBREVIATION

<i>et al.,</i>	=	and others
ANOVA	=	Analysis of Variance
AOAC	=	American Organization of Analytical Chemists
gm	=	Gram
mg	=	Milligram
ml	=	Milliliter
min	=	Minute
°C	=	Degree Centigrade /Celsius
mc	=	Moisture Content
DPPH	=	2, 2-diphenyl-1-picrylhydrazyl
TPC	=	Total phenolic content
TFC	=	Total flavonoid content
BBS	=	Bangladesh Bureau of Statistics

CHAPTER I

INTRODUCTION

“Good bread is the most fundamentally satisfying of all foods; and good bread with fresh butter, the greatest of feasts” — James Beard (1973)

Pumpkins are fruits of several plants belonging to the *Cucurbita* genus and the Cucurbitaceae family. *Cucurbita moschata*, *Cucurbita maxima* and *Cucurbita pepo* are three of the most cultivated species worldwide. *Cucurbita* is one of the most commercially valuable genera of vegetable crops (Paris *et al.*, 2010).

Pumpkin (*Cucurbita moschata*) is an important vegetable crop in Bangladesh due to its great economic importance, nutritional value, and high availability all year-round. In Bangladesh, vegetables are essential to the country's overall economic performance. Pumpkin, one of the most significant and well-liked vegetable crops, is farmed all over tropical and subtropical regions. Pumpkin is a crop that has a high nutritional value and lucrative market price, making it a valuable commodity. In Bangladesh, several culinary preparations use both immature and mature vegetables as essential ingredients.

According to the 2022 report of Bangladesh Bureau of Statistics, 145205.83 metric tons of pumpkins have been produced in 3014.24 acres of land in Bangladesh. Khulna division has the highest production of 53305 metric tons on 8685 acres of land and 30161.12 metric tons of pumpkin on 5765.14 acres of land in Dhaka division (BBS 2022).

Pumpkins are grown in various parts of the world for their pulp and seeds for human nutrition, either for direct use or for the formulation of other ingredients, such as syrups, jellies, jams, bread, and purres and many products (Provesi *et al.*, 2011; Kim *et al.*, 2012).

Pumpkin pulp has the dietary and health safety importance of proteins, polysaccharides such as pectin, carotene, mineral salts, minerals (potassium, phosphorus, magnesium, iron, and selenium), vitamins (vitamin A, riboflavin, vitamin B₆, vitamin C, vitamin E, vitamin K) and some substances such as phenolic compounds (flavonoids & phenolic acids) amino acids and terpenoids (Kampuse *et al.*, 2015; & Pereira *et al.*, 2020). These biologically active components have been shown to possess a wide range of medicinal properties such as anti-hypertensive, bactericide, anti-diabetics, anti-inflammatory, anti-carcinogenic and antioxidant properties (Malkanthi *et al.*, 2020 & Adams *et al.*, 2011).

Pumpkin is a traditional crop with high potential to overcome undernourishment and food poverty (Ondigi *et al.*, 2008). Reliable data on carotenoid analysis is urgently needed, as this research area is developing its own potential for human health and is also important to the food and pharmaceutical industries.

Carotenoids, in particular β -carotene, have been described as the pigment responsible for the yellowish appearance of the pumpkin (Lee *et al.*, 2002). Vitamin-A is recognized as a powerful natural antioxidant and is important to protect the health of the skin and mucosa, as well as the essential vitamin for healthy eyesight (Toan *et al.*, 2018). However α , β -carotenes, lutein, cryptoxanthin, and zeaxanthin, among other compounds present in pumpkin (Ma *et al.*, 2010).

Pumpkin can be used as a primary vegetable to meet the carotenoid requirements of children (Malkanthi *et al.*, 2018). On the other hand, it is therefore practical to develop pumpkin products rich in carotenoids. Pumpkin can be refined into flour and has a longer shelf life. Pumpkin flour is used for the fortification of wheat and the preparation of porridge due to its highly attractive flavor, richness, and rich yellow orange color (Nakazibwe *et al.*, 2019).

This makes it an excellent opportunity to manufacture pumpkin flour (Guine *et al.*, 2011). One of the challenges of plant breeding is to balance nutritional quality with good industrial yields and reduce post-harvest losses. Producing foods with nutritional characteristics that are similar to normal, responsive, and enjoyable products that are stable during storage is the industry's most significant challenge in meeting customer demands (Silva *et al.*, 2011).

With all these medicinal values and efficient ingredients in value added products the utilization of pumpkin bread in convenience food has a long way to utilize the pumpkin vegetables with value addition for marketability and creating employment opportunities for rural women for economic empowerment.

The utilization of pumpkin pulp in an industrial level is important for product market strategy. Hence, the study of pumpkin bread was undertaken with following specific objectives:

1. To investigate the impact of steam pumpkin pulp and pumpkin powder on the quality of breads.
2. To evaluate the physico-chemical properties, nutritive value and sensory characteristic of developed bread samples.

CHAPTER II

REVIEW OF LITERATURE

2.1 Bread

Bread is a fermented confectionary product which is produced mainly from wheat flour, water, yeast and salt by a series of processes involving mixing, kneading, proofing, shaping and baking (Ahemen *et al.*, 2018). Bread is a staple food in both developing and developed countries and form one of the important sources of macro-and micro-nutrients such as carbohydrate, protein, fiber, vitamins and minerals in the diets of several people around the world. Bread is mainly prepared by baking dough usually made from wheat flour. The primary components needed to make bread are flour, salt, water, and yeast or baking powder. Approximately 60% of wheat is utilized as a foundation component in bread making (Akubor, 2003). Other bread enriching ingredients could be sugar /sweeteners, milk, fats, egg, fruits and fruit juices, spices and enzymes.

2.2 Pumpkin

2.2.1 History of pumpkin

A pumpkin is a squash belonging to the *Cucurbita* genus and *Cucurbitaceae* family, which also includes gourds, that resembles a gourd. It commonly refers to cultivars of any one of the species *Cucurbita pepo*, *Cucurbita maxima*, and *Cucurbita moschata*, and is native to North America. They often have a thick, orange or yellow shell that is folded from stem to bottom and contains the seed and pulp. Pumpkins are widely cultivated for commercial purposes and have culinary and medicinal uses (Itis. Gov. 2009). The Greek term pepon, which means huge melon, is where the word pumpkin first appeared.

This word was transformed to pompon by the French, then to pumpion by the British, and finally to "pumpkin" by the American colonists. The origin of pumpkins oldest evidence, pumpkin-related seeds dating between 7000 and 5500 BC, were found in Mexico Pumpkins are a squash-like fruit that range in size from less than 1 pound (0.45 kilograms) to over 1,000 pounds (450 kilograms) (The Columbia Encyclopedia. 2004). Pumpkin grows in all the districts of Bangladesh but plenty of pumpkins are produced in the region of Jessore, Kustia, Chittagoang and Dhaka (BBS 2022).

2.3 Varieties of Pumpkin

There are many varieties of pumpkin worldwide. Some are termed as summer fruit, some are winter fruit and some are creamy fruits. Amongst them in Northern Bangladesh mainly three types are produced locally it is termed as "Misti kumra". The varieties of pumpkin that are common are given in Table 2.1.

Table 2.1: Varieties of Pumpkin

Species	Plants	Native Country	Types of Pumpkin
<i>Cucurbita pepo</i>	Pumpkin, acorn squash, zucchini, spaghetti squash, delicate squash, small gourds	United States, Mexico	Bright skin orange Hrad, woody, stem with ridges
<i>Cucurbita maxima</i>	Very large pumpkin, winter squash, buttercup squash, hubbard squash, turban squash, banana squash, large gourds	Chile, Argentina, Bolivia, Uruguay	Yellow skin, soft stem like a sponge or cork
<i>Cucurbita moschata</i>	Pumpkin, winter squash, butternut squash	Mexico, Peru	Yellow skin, soft stem like a sponge or cork

2.4 Production of Pumpkin

Pumpkin is a popular vegetable that is grown all over the world. It is a common vegetable in China, India, Russia, the United States, and Egypt, among other places. In 2016, nearly 67,000 acres of pumpkin were grown in the United States, yielding 16 million pounds of pumpkins, according to the USDA National Agricultural Statistics Service. China produces about half of the world's pumpkins, but it eats the majority of its own. It grew 7838809 tons of pumpkins in 2016. FAOSTAT (2016) conducted a global survey of pumpkin, squash, and gourd production and production prices, as shown in Table 2.2.

Table 2.2: Top 10 World Producers of Pumpkins, Squash and gourds, Ranked by Production

Area	Production (Metric Ton)
China	7,297,548
India	4,987,123
Russian Federation	1,232,162
Ukraine	1,104,550
United States of America	863,460
Iran	603,629
Mexico	566,960
Italy	566,585
Cuba	499,820
Spain	462,266

Source: FAOSTAT (2016)

2.5 Production of Pumpkin in Bangladesh

Pumpkin is a very popular and one of the most important vegetable crops grown extensively in tropical and subtropical countries. Pumpkin is a high value crop because of its high nutritional content and profitable market price. Both immature and mature vegetables are used as vital ingredients in several culinary preparations in Bangladesh. Pumpkins are rich in carbohydrates, minerals and cheaper source of vitamins, especially carotenoid pigment, which has a major role in nutrition in the form of pro-vitamin A antioxidants, when used at the ripening stage. Thus, this vegetable can help to improve the nutritional status of the people of Bangladesh, particularly the vulnerable group, in terms of vitamin-A requirements. Among all the vegetables produced in the country, pumpkin covers the majority of the total area covered of total cropping area and production. It grows in all Bangladesh's districts, but the Jessore, Kustia, Chittagong and Dhaka regions produce the most pumpkins (BBS, 2014).

2.6 The Importance of Value-Added Products in Reducing Post-Harvest Losses

Post-harvest losses of fruits and vegetables are a critical issue in many developing countries, including Bangladesh. According to the Food and Agriculture Organization (FAO), approximately 30–40% of fruits and vegetables are lost in these regions due to spoilage and inadequate preservation methods (Elik *et al.*, 2019). This significant level of wastage not only

results in economic losses but also poses challenges to food security. Among the various fruits and vegetables, pumpkins are particularly affected, with substantial portions of the harvest going unused.

For instance, pumpkin bread presents an effective solution to minimize wastage. By transforming pumpkins into bread, it is possible to create a nutritious and appealing product that can serve as an alternative to conventional bread. The production of pumpkin bread not only helps reduce post-harvest losses but also enhances food security by providing an additional source of income for farmers and processors. Moreover, it contributes to improving the nutritional intake of the population by offering a healthy snack option that incorporates the beneficial nutrients found in pumpkins.

2.7 Compositions of pumpkin

Pumpkin is one of the important vegetable with high nutritive value. It is a low-calorie vegetable with a rich source of carotene, vitamin, minerals, pectin and dietary fiber (Djutin *et al.*, 1991).

Table 2 .3: Nutrient composition of pumpkin pulp powder (Malkanthi *et al.*, 2018)

Parameters	Pumpkin pulp powder
Moisture (g)	14.80±1.2
Ash (g)	5.56±0.18
Protein (g)	8.95±0.05
Crude fiber (g)	3.25±0.89
Fat (g)	0.86±0.03
Carbohydrate (g)	67.00
Energy (kcal)	313.00
Vitamin C (mg)	6.19±2.6
Beta-carotene (mg)	32. 87±0.61
Potassium (mg)	2690.54±12.54
Calcium (mg)	21.30±1.90
Magnesium (mg)	154.46±9. 51
Phosphorus (mg)	39.15±1.07
Zinc (mg)	2.28±0.18
Iron (mg)	8.33±2.29
Total polyphenol content (mg GAE/100 g)	192 84±5.15
Antioxidant activity (mmol AAE/100g)	0.53±0.0

The vegetable contain vitamin A, B, C and E flavonoid and poly- phenolic antioxidants such as lutein, xanthan etc. (Matus *et al.*, 1993). Pumpkin powder has been screened for chemical composition from which inference can be drawn for its suitability for functional food.

The major B complex major group of vitamins present in pumpkin are folate, niacin, thiamine, pantothenic acid and vitamin B₆ (pyridoxine) (Foster & Flood, 1995). Further, the vegetables has been considered as beneficial to health because it contains various biologically active components such as polysaccharides, para-amino benzoic acid, fixed oils, sterols, protein and peptides (Caili *et al.*, 2006). The vegetable is a good source of carotenoids and gama amino butyric acid (Murkovic *et al.*, 2002). Are also valued for their high protein content and essential Further, the seeds are also valued for their high protein content and essential fatty acids, like linoleic acid (Glew *et al.*, 2006). These seeds also contain large amounts of various essential micro elements such as K, Ca and Na along with Mg, Zn, Cu, Mo and Se etc. (de-Escalada Pla *et al.*, 2007). Pumpkin also contains some bioactive compounds such as D-Chiro- inositol and antidiabetic which increase the insulin secretion and increase β -cell mass (Xia and Wang *et al.*, 2007). The phenolic phytochemicals are also antidabetic in function increase which helps in α - Glycosidase inhibition (Kwon *et al.*, 2007).

2.8 Utilization of Pumpkin

2.8.1 General utilization of pumpkin

Pumpkin is widely cultivated in temperate and subtropical zones of the world for an edible and therapeutic purpose (Al-Rowais *et al.*, 2002). It has been traditionally used as a vegetable as well as medicine in many countries, such as Mexico, India, China, Brazil, America, Argentina and Yugoslavia (Adolfo and Michael, 2005). In Mexico, *Cucurbita ficifolia* is consumed widely and several dishes and candies are prepared with the seeds or fruit (Andrade-Cetto and Heinrich, 2005) *Cucurbita moschata* is used for developing salty or sweet food products (de Escalada Pla *et al.*, 2007). Seeds of pumpkin are high in protein, oil and mineral content and are eaten raw or pressed to make oil (Hopkins *et al.*, 1996). Different products like jams, sweet, marmalade, beverage, baby food, ice-cream and chocolates are prepared from the pumpkin (Pongjanta *et al.*, 2006) It is processed in different ways for human consumption, such as fried, frozen, dried, candies or pickled. Pumpkin can be processed into flour, which has a larger shelf life Further, pumpkin flour is used in preparation of different products because of its highly desirable flavour, sweetness and deep yellow orange colour It has been reported to be used to supplement cereal flours in bakery

products, preparing soups, sauces, instant noodle and spice as well as a natural colouring agent in pasta and flour mixes (Pongjanta *et al.*, 2006). Pumpkin powder can be used as the concentrated source of β -carotene in bakery and confectionery products (Sudipta and Soumitra, 2015).

2.8.2 Weaning Properties of Pumpkin

Pumpkin is second only to apple as the first fruit introduced into children's diets in Australia (Koh *et al.*, 2014). Ezeji and Ojimekwe (1993) created a weaning mix using fluted pumpkin seed flour with Bambara ground nuts and fermented millet seed. A beverage made of whole dried milk and dried pumpkin flakes was created by Fernandez *et al.*, (1998) to give a 6- to 12-month-old baby 400 milliliters a day of 100% vitamin A and protein RDA. Hashim and Pongjanta (2000) and Jirapa *et al.*, (2001) have a more complex mix of cowpea flour, rice flour, banana-pumpkin, skim milk powder and sugar in a 35:3:15:15:5 ratio. Freeze drying retained more nutrients than oven drying and 100g of freeze-dried weaning food provided an adequate amount of the recommended daily allowance (RDA) of vitamin A for infants. Usha *et al.*, (2010) started with a mix of sorghum, green gram and rice in a 2:1:1 ratio. Pumpkin powder added at 20 percent significantly increased protein, fiber, carbohydrate, and antioxidant levels, while maintaining good sensory qualities. Ward and Ainsworth (1998) added pumpkin seed oil to a traditional Kenyan porridge to increase its calorie and protein content to acceptable levels.

2.9 Medicinal Properties of Pumpkin

Cancer

Aghaie *et al.*, (2015) examined ways to lessen the cyclophosphamide, a cancer treatment drug that is harmful to reproduction. Sharma *et al.*, (2015) suggested a preventative effect of cucurbit on bowel cancer, but Tarrazo-Antelo *et al.*, (2014), "observed a reduced risk for broccoli and pumpkin intake. Although fruit consumption does not appear to be linked to a lower risk of lung cancer, frequent eating of particular green leafy vegetables and other vegetables may be."

Diabetes

Bayat *et al.*, (2016) describe the benefits of *Cucurbita ficifolia* with probiotic yogurt, a traditional Iranian therapy. Boaduo *et al.*, (2014) investigated the effects of *Cucurbita pepo* (summer squash), a traditional South African remedy, and an unnamed *Cucurbita* on diabetic rats in a study conducted by Makni *et al.*, (2011). Teugwa *et al.*, (2013) concluded, "These

findings showed that the selected Cucurbitaceae seeds of *Cucurbita moschata* contained globulins with significant anti-hyperglycemic activity." It is thus strongly advised to do research into the creation of peptide-drugs and/or phytomedicines derived from these bioactive proteins that might be utilized as an economical alternative therapy for diabetes mellitus."

Anti-medicinal Properties of Pumpkin

There are several publications on pumpkin allergies, however they mostly address compounds in the fruit's skin rather than the flesh itself. Arochena *et al.*, (2012) wrote about supermarket workers affected by handling the fruit, La Shell *et al.*, (2010) wrote about adolescents and Potter and Hashimoto (1994) wrote about dermatitis on adults.

Anti-oxidant activities

Pumpkin seed oil is a rich source of antioxidants (active beneficial components that may protect important biological molecules from oxidative stress) and polyunsaturated fatty acids, some researchers believed that there are some benefits associated with the administration of poly-unsaturated fatty acids in cases of prostate disorders (Levin, 2008) Pumpkin flesh and seeds are rich in antioxidant vitamins such as β -carotene and α -tocopherol β -carotene reduce skin damage from the sun and acts as an anti-inflammatory agent also it is thought to slow the aging process, reduce the risk of developing cataracts, and prevent tumor growth. The potent anti-inflammatory action and powerful anti-oxidant action of the beta-carotene has been effectively demonstrated in laboratory studies, β -carotene is one of the most effective organic compounds around, helping in the effective prevention of cholesterol oxidation under laboratory conditions. This compound's function is particularly beneficial because oxidized cholesterol is a type of sterol that frequently builds up in blood vessel walls and may increase a person's risk of heart attack and stroke. For this reason, the progression of atherosclerosis and heart disease in the body may possible be slowed down by regular high intake of the β -carotene from dietary sources (Adaramoye *et al.*, 2007). Vitamin E (α -tocopherol) protects the cell from oxidative damage by preventing the oxidation of unsaturated fatty acids in cell membrane (Stevenson, *et al.*, 2007).

2.10 Drying Techniques for Pumpkin

Doymaz (2007) carried out studies on the kinetics of forced convective air-drying of pumpkin slices. He reported that drying of pumpkin slices at a constant air velocity of 1.0 m/s,

temperature range of 50-60°C and relative humidity range of 15-25% did not observe a constant rate period of drying. The kinetics of hot-air and infrared drying of carrots were compared by Nema (2004). His findings demonstrated that infrared drying eliminates 45.2 percent more moisture than hot air drying after 90 minutes at 65° C. Thermal treatment is one of the most essential methods of pumpkin preservation, according to Dutta *et al.*, (2006). Its purpose is to inactivate the pathogen as well as other deteriorating bacteria that could render it unfit for human consumption. It also enhances carotene bioavailability by breaking down the cellulose structure of plant cells. Hong and Lee (2004) used three different drying methods to dry somatically prepared sweet pumpkin: hot air, vacuum, and cold air drying. Cold air drying produced more vitamin C content and a lower color difference than other procedures, according to the findings. The lack of water caused cell breakdown in cold air dried sweet pumpkin, according to microscopic research.

2.11 Some Other Researches on Pumpkin

Recent studies have explored various aspects of pumpkin-based products and byproducts, focusing on their nutritional, antioxidant, and antimicrobial properties.

Temesgen Laelago Ersedo (2019) conducted a study on the nutritional composition of the pumpkin (*Cucurbita maxima L.*) flour. The objective of this work was to evaluate the developed composite flour breads were made by adding others ingredients and its proximate and sensory acceptability were analyzed. The wheat flour was made as control with BP0 (100% wheat flour) and four pumpkin and wheat blends: BP1 (95% wheat & 5% pumpkin flour), BP2 (90% wheat & 10% pumpkin flour), BP3 (85% wheat & 15% pumpkin flour) and BP4 (80% wheat & 20% pumpkin flour) The researcher found average moisture (11.25-9.20%), ash (0.91-1.73%), crude protein (6.12-5.29%), crude fiber (0.21-0.69%), crude fat (15.66-19.23%) and carbohydrate (65.76-63-86%). The researcher showed that the moisture content, crude protein, and utilizable carbohydrates of the composite flour bread reduced as the pumpkin flour ratio in the blend increased. However, as the quantity of pumpkin in the pumpkin wheat composite flour bread blends increased, so did the ash, crude fat, crude fiber, and energy content. Sensory tests employing a five-point hedonic rating revealed that the bread sample with 10% dried pumpkins had a higher degree of liking when compared to the control wheat bread and other samples. The effect of adding pumpkin flour to wheat flour in varying proportions resulted in higher than average consumer-oriented panelist evaluations for overall acceptance of the breads.

See *et al.*, (2007) performed a research on physico-chemical and sensory evaluation of breads supplemented with pumpkin flour. The researchers objective were to determine the physico-chemical and sensory characteristics of bread supplemented with four different levels (control, 5%, 10%, and 15%) of pumpkin flour. The researchers found that average weight (151.45-157.45) g, volume (901-759.50) ml, specific volume (5.95-4.89) cm³. The researchers observed that the average moisture (32.09-35.32%), ash (1.83-2.43%), fat (2.59-2.44%), protein (15.72-14.47%), crude fiber (1.56-2.90%) and carbohydrate (46.28-42.44%). The researcher showed that the fat content, crude protein and utilizable carbohydrates of the composite flour bread reduced as the pumpkin flour ratio in the blend increased. However, as the quantity of pumpkin in the pumpkin wheat composite flour bread blends increased, so did the moisture, ash, and crude fiber. In this research, sensory evaluation results indicated that bread with 5% pumpkin flour was rated the most acceptable and was not significantly different in terms of acceptability compared to the control.

Wahyono *et al.*, (2020) evaluate the effect of pumpkin flour enrichment to the antioxidant activity and total phenolic content of bread. Breads were developed by partially replacing wheat flour with pumpkin flour at a ratio of 5% to 20%. The researchers found that pumpkin flour significantly enhanced antioxidant activity of enriched bread measured by DPPH and ABTS. The maximum antioxidant activity was found in bread enriched with 20% pumpkin flour. At highest values, antioxidant activity was 76.59% (DPPH) and 81.74% (ABTS), respectively. They observed that the total phenolic content of pumpkin enriched bread ranged from 4.16 mg GAE /g to 16.16 mg GAE /g. The bread enriched with 20% of pumpkin flour presented the highest total phenolic content (16.16 mg GAE/g). On the contrary, the control bread had the lowest total phenolic content (4.16 mg GAE/g). The researchers showed that increase the level of pumpkin flour produced a higher level of total phenolic content in enriched bread. Finally, they concluded that pumpkin flour can be employed to enhanced antioxidant activity and total phenolic content of bread.

Różyło *et al.*, (2014) determined the influence of the addition of fresh pumpkin pulp directly into wheat flour on physical, sensorial and biological properties of bread. The bio-accessibility of active compounds was also studied. They found that an increase in the addition of pumpkin pulp from 5 to 20 % (converted to dry matter) caused a decrease of bread volume and increase of crumb hardness and cohesiveness. The sensory characteristics of the bread showed that a partial replacement of wheat flour with up to 10 % of pumpkin

pulp gave satisfactory results. The highest antioxidant activity was observed, in most cases, of the samples with added 10 and 15 % of pumpkin pulp.

Khan MA et al. (2019) investigated the influence of pumpkin flour on the physicochemical, rheological, nutritional, and sensory properties of biscuits by integrating pumpkin flour at percentages ranging from 5-25% based on refined wheat flour (Maida). They showed that average moisture (3.52-3.69%), ash (0.56-1.28%), protein (7.23-6.54%), fat (13.34-14.10%), Fiber (0.82-1.86%), carbohydrate (74.56-72.53%) and carotenoids (6.51-23.82 μ g/g). The researcher found that the moisture content, ash, fat, fiber and carotenoids of the composite flour biscuits increased as the pumpkin flour ratio in the blend increased. However, as the quantity of pumpkin in the pumpkin wheat composite flour biscuits blends decreased, so did the protein and carbohydrates content.

Mala and Kurian (2016) assessed the nutritional composition and antioxidant activity of pumpkin waste, specifically peel and pulp. They found that the peel is rich in phosphorus, iron, and dietary fiber, while the pulp is a significant source of β -carotene. Both peel and pulp showed similar levels of polyphenols and antioxidant activity. This study suggests that pumpkin waste can be effectively utilized for its nutrient and antioxidant properties, potentially enhancing food formulations.

CHAPTER III

MATERIALS AND METHODS

3.1 Experimental Site

The experiment was conducted in the Food and Process Engineering Lab-1 and Lab-2 under the faculty of Engineering Hajee Mohammad Danesh Science and Technology University, Dinajpur. Some proximate analyses were also accomplished in the laboratories under the department of Agricultural Chemistry, Hajee Mohammad Danesh Science and Technology University.

3.2 Sample Collection

Fresh and mature pumpkin (*Cucurbita moschata*) (figure 3.1) which was in the ripen stage purchased from the local market in Dinajpur district (Baserhat) during the harvesting season (August-September 2023). These pumpkins were stored at room temperature before analysis.



Fig 3.1: Freshly collected Pumpkin

3.3 Equipment required

The equipments required for the experiment were given below;

Micropipette (10-100 μ l and 100-1000 μ l), Pipette (1-10 ml), Volumetric flasks (50-100 ml), Conical flasks (250-500 ml), Beakers (50-500 ml), Falcon tubes (15-50 ml). Measuring cylinder (50-100 ml), Spectrophotometer (UV/VIS, 1800), Hot air oven. Cabinet dryer, Water bath, Vortex mixture, Centrifugal machine, Magnetic Stirrer with hot plate. Stainless steel tray etc.

3.4 Reagents required

The chemicals required were used from the laboratory stock. The lists of chemicals used in the research work were listed below;

Gallic acid, Folin-Ciocalteu reagent (FCR), Sodium Carbonate (Na_2CO_3), Sodium nitrite (NaNO_2), Aluminum chloride (AlCl_3), Sodium hydroxide (NaOH), Hydrochloric Acid (HCl), DPPH (2, 2-diphenyl-1-picrylhydrazyl), Sulfuric Acid (H_2SO_4), Methanol, Ethanol, Acetone and Hexane etc.

3.5 Sample and product preparation procedure

3.5.1 Preparation of pumpkin flour

The pumpkin was washed, cut into large pieces, its seeds removed, and its fluffy portion (fibrous part) was peeled off and grated into small shreds using shredder. The shredded pumpkin was drying in a lab scale multipurpose universal cabinet dryer at 60-65 °C for 18 hours. The dried pumpkin shreds were ground into fine powder using a kitchen grinder and sieved through a 300 mesh sieve. The prepared pumpkin flour was stored in an airtight container at 4°C in a refrigerated condition for further study.

The flow chart for preparing of pumpkin flour is given below:

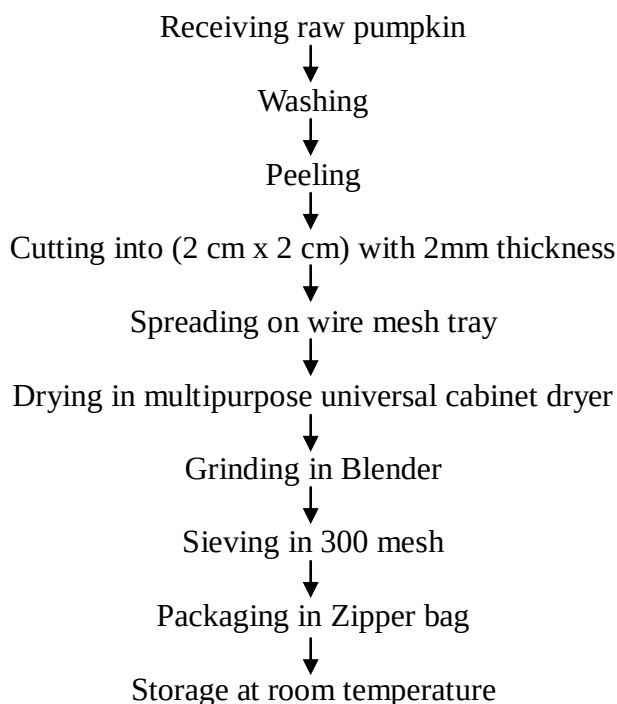


Figure 3.2: Flow chart of preparation of pumpkin flour

Picture taken from different stage of my works



Fig. 3.3 raw Pumpkin



Fig.3.4 Pumpkin before drying



Fig.3.5 Pumpkin flour

3.5.2 Preparation of steam pumpkin pulp

The pumpkin was washed, cut into large pieces, its seeds removed, and its fluffy portion (fibrous part) was peeled off. Then the chopped pieces were weighted and steamed (10 -12 m). Finally the steam pulp was mortared and pestled.

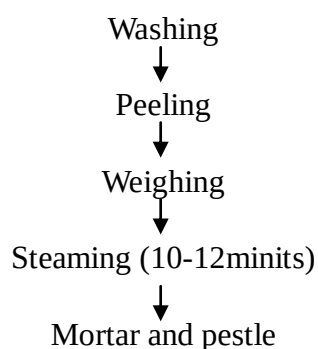


Figure 3.6: Flow chart of preparation of steam pumpkin pulp

3.5.3 Preparation of bread

Table 3.1: Incorporation of pumpkin flour and pulp at different levels (per 100g)

Sample	Wheat flour	Pumpkin pulp flour	Steam pumpkin pulp
S ₁ (Control)	100	0	0
S ₂	95	5	0
S ₃	93	7	0
S ₄	95	0	5
S ₅	93	0	7

Here, Sample 1 (Wheat flour), sample 2 (5% pumpkin flour), sample 3 (7% pumpkin flour), sample 4 (5% steam pumpkin pulp) and sample 5 (7% steam pumpkin pulp). All these values were selected after trial and error.

Table 3.2: Other ingredients amount for dough preparation (per 100 g of flour)

Ingredients	Amounts	Ingredients	Amounts
Yeast	4 g	Vegetable oil	9g
Salt	1.5 g	Milk Powder	6g
Sugar	16g	Water	30ml (Approx.)

Bread preparation:

The first yeast suspension was made by combining yeast, warm water, and sugar and setting aside for 10 minutes. All of the remaining components, including the yeast suspension, were thoroughly combined. The dough was slowly stirred in until it felt smooth to the touch. The dough was allowed to rise for 1:15 hours but was not allowed to ferment too long. Next, punch and shape the dough into a bread box. The bread box was first proofed in an oven at 45°C for 15 minutes before baking at 175°C for 20 minutes. The samples were analyzed two hours after baking. Bread loaves were packaged in perforated, orientated polypropylene film.



Fig. 3.6 Prepared bread samples

3.6 Determination of physical properties of the bread**3.6.1 Bread Weight**

The method adopted by Mannuramath *et al.*, (2015) was used with some modification. Bread loaves were weighed an hour later the bread was brought out of the oven, using a laboratory scale balance. The readings were recorded in grams.

3.6.2 Loaf Height, Length and Breadth

Loaf height, length and breadth of the bread loaves were measured with a measuring scale and readings were recorded in centimeters.

3.6.3 Loaf Volume and Specific Volume

Seeds were loaded into an empty box with calibrated mark until it reached the marked level and unloaded back. The bread sample was put into the box and the measured little millet grains were loaded back again. The remaining little millet grains left outside the box was measured using measuring cylinder and recorded as loaf volume in cm³. Specific volume was calculated as volume to weight ratio (cm³/g) (Rosales-Juárez *et al.*, 2008).

$$\text{Specific volume} = \frac{\text{Loaf volume}}{\text{Loaf weight}}$$

3.6.4 Density

Density was calculated using formula adopted by Mannuramath *et al.*, (2015).

$$\text{Density} = \frac{\text{Weight of loaf sample}}{\text{Volume of loaf sample}}$$

3.6.5 Crumb Firmness

Crumb firmness was measured by Penetrometer (using a 0.8mm diameter plunger).

3.6.6 Assessment of Coloring:

The color of flour was measured using a colorimeter (BIOBASE Colorimeter BCM-200) based on the parameters L*, a* and b* (Himida *et al.*, 2012). The values of (L) represent the brightness or luminance of the flour, the higher the value, the more the flour is clear, (a) the green-red balance and b the blue-yellow balance.

3.6.7 Crust-Crumb Ratio

The crust/crumb ratio of five breads was assessed 3 hr after baking. Breads were first weighed. Then, bread crumb was removed uniformly from the crust by hand. The separation between crumb and crust was determined by the fact that crumb can be removed from the crust with a very low force. The mass of the remaining crust was measured. The crust to crumb ratio was then calculated and dried at 100°C for 24 h. The moisture loss was calculated by the weight loss as a percentage of the initial weight of the sample. Four measurements of bread crumb moisture loss were obtained for each bread-making process (Barett *et al.*, 2005).

3.7 Proximate Analysis

The bread samples were evaluated to determine their nutritional composition. The parameters measured corresponding to ideal methods were moisture, ash, protein, fat, crude fiber and carbohydrate compositions.

3.7.1 Determination of Moisture Content

The moisture content of bread was determined in accordance with moisture measurement by Association of the Official Analytical Chemists (AOAC) method (AOAC, 2016).

Principle

The sample is heated under specified conditions to evaporate the moisture in it and losing weight is used to calculate the moisture content of the sample.

Equipments

- Hot air oven
- Petri dish
- Analytical balance

Procedure

At first, the weights of previously dried (1 hour at 105±5°C) empty petri dish were taken and 3 g of samples were placed on the petri dish. This petri dish with sample was dried in an air oven at 105°C for 24 hours for constant weight. After drying, the petri dish was removed from the oven and cooled in the desiccator. The petri dish was removed from desiccator and weighed soon after reaching room temperature. The losses of weight were considered as the moisture loss of the sample. This process was triplicated for each sample to get more accurate result. From these weights, the percent of moisture in the samples were calculated as follows:

$$\text{Moisture} = \frac{\text{Loss of weight}}{\text{Weight of sample}} \times 100$$

3.7.2 Determination of Ash

Total ash content of bread was determined by adopting AOAC method (AOAC, 2016)

Principle

Water and other volatile materials are vaporized and organic substances are burned in the presence of the oxygen and converted to CO₂, H₂O and N₂, and the weight of the residue is used to calculate the ash content of the sample.

Equipments

- Hot air oven
- Muffle furnace
- Crucible
- Analytical balance

Procedure

Two grams of each sample was taken in a clean, dry, previously weighed empty crucible. Then the crucible was transferred into the muffle furnace and burnt at 550°C for 6 hours until light gray ash resulted. The crucible was then cooled in desiccator and weighed. This process was triplicated for each sample to get more accurate result.

The ash content was expressed as:

$$\% \text{ Ash} = \frac{\text{Weight of residue}}{\text{Weight of sample}} \times 100$$

3.7.3 Determination of Fat

Total fat content of bread was determined by AOAC using Soxhlet apparatus (AOAC, 2016).

Principle

Fat is extracted with an organic solvent. Solvent is heated and volatilized, then is condensed above the sample. Solvent drips onto the sample and soaks it to extract the fat. At 15-20 min intervals, the solvent is siphoned to the heating flask, to start the process again. Fat content is measured by weight loss of sample or weight of fat removed.

Equipments

- Soxhlet apparatus
- Heating mantle
- Round bottom flask
- Cellulose thimble
- Analytical balance

Procedure

About 3 g of dried sample was taken into a trace paper and placed in a thimble. Top of the thimble plugged with fat free cotton. Then the thimble was dropped into the fat extraction tube of a Soxhlet apparatus. Bottom of the extraction tube was attached to a Soxhlet flask. Approximately 175 ml of anhydrous petroleum ether was poured into the flask. Meantime the top of the fat extraction tube was attached to the condenser. Fat from the sample was extracted for 6 hours at 80°C. The water bath was regulated so that was condensed and dropped 5/6 drops per second continuously upon the sample without any appreciable ether

which volatilized loss. At the end of the extraction period, the thimble was removed from the apparatus and most of the ether of heating flask was distilled off by allowing it to collect in the Soxhlet tube. Then the ether was recycled when the tube was nearly full. When the ether was reached to a small volume, it was poured into a dry (previously weighed) petri dish. All of the ether was evaporated in a drier at 100°C for 1 hour, cooled and weighed. Difference in the weights was the ether soluble material present in the sample. The percent of crude fat was expressed as follows:

$$\% \text{ Fat} = \frac{\text{Weight of residue}}{\text{Weight of sample}} \times 100$$

3.7.4 Determination of Protein

AOAC method was used with some modification to determine the protein content of bread (Association of the Official Analytical Chemists (AOAC), 2016), usually, three stages used to determine protein content. These stages are given below:

Digestion

Sample (1g), Selenium powder (1g), CuSO₄ (0.1g), K₂SO₄ (10g) was taken into a volumetric flask. Then 25ml of H₂SO₄ (conc.) was added. After that the volumetric flask was heated at 350 °C for 3 hours and it was cooled for 20 minutes at room temperature.

Distillation

After digestion, 300 ml of distilled water and 125 ml of 40% NaOH was added to the volumetric flask. Then 25 ml of 4% boric acid solution and 2-3 drops mixed indicator was added in a conical flask. The volumetric flask was connected with one end of the condenser and the conical flask was connected with another end. The volumetric flask was heated continuously until the conical flask was filled to 150 ml.

Titration

The conical flask was disconnected and taken for titration against 0.2 N of H₂SO₄ solutions. The end point was indicated by orange color.

This process was triplicated for each sample to get more accurate result.

Calculation

i) Calculation for N₂ content:

$$\% \text{ of N}_2 = \text{Burette reading} \times \text{Normality of H}_2\text{SO}_4 \times \text{ml equivalent of N}_2$$

Here,
 Normality of H_2SO_4 = 0.2
 ml equivalent of N_2 = 1.4

ii) Calculation for protein content: % Protein = % of N_2 × Protein factor

Here;

Protein factor = 6.5 (Hawkey *et al.*, 2021; Salo-Väänänen & Koivistoinen, 1996)

3.7.5 Determination of Total Carbohydrate

Rather than analyzed directly, total amount of carbohydrate in foods has been calculated by difference (Rak *et al.*, 2020) As the other constituents in the food (moisture, protein, fat and ash) were determined individually, they are summed and then subtracted from the total weight of the sample. Total carbohydrate is calculated by the following formula:

Carbohydrate = $100 - (\% \text{Moisture} + \% \text{Ash} + \% \text{Fat} + \% \text{Protein} + \% \text{Fiber})$.

3.7.6 Determination of Fiber

Crude fiber of the sample was determined sequentially by acid and alkali hydrolysis followed by ignition of the residue as described the method AOAC (2000)

Equipments

- Beaker
- Muffle furnace
- Filter paper
- Electric heater
- Electric oven
- Tong

Procedure

About 5g sample was taken in a beaker and added 200ml of 1.25% H_2SO_4 (98%). Then it was boiled for 30 minutes and filtered through whatman no.42. After that the residue was taken in a beaker again and mixed with 200 ml of 1.25% NaOH (0.3125 N) and boiled 30 minutes. Again, it was filtered with whatman no.42 and residue was kept in an oven for drying at 2 hours. The dried portion was weighted and kept in a muffle furnace at 550°C for 6 hours. Then the fiber content was determined by following equation.

$$\% \text{ Crude fiber} = \frac{\text{Loss of weight}}{\text{Weight of sample}} \times 100$$

3.8 Determination of total Carotenoids Content

Carvalho *et al.*, (2014) method was followed for the determination of total Carotenoid Content. Two gram of each sample was placed into a tube and 10 mL acetone was added. Then it was mixed for 10 minutes by vortex mixture. After that mixture was filtrated by Buchner funnel through what man no.41. This procedure was repeated until the sample become Colorless. Then the extract was transferred to a separating funnel containing 40ml of petroleum ether. Next 5 ml of distilled water and a pinch of anhydrous sodium sulfate was added and mixed smoothly. The aqueous phase was discarded and upper layer was collected. This procedure could be repeated with discarded portion and collected the total Color portion. The total volume of colored portion was measured by measuring cylinder. Then absorbance was read at 450 nm using a spectrophotometer (UV/VIS, UV-1800). The total carotenoid content was obtained using the following formula.

$$\text{Carotenoid Content } (\mu\text{g}) = \frac{A \times V \times 10^4}{A^{1\%} \times 1 \text{ cm} \times W}$$

Here, A=Absorbance at 450 nm, V=Total extract volume (mL), W=Weight of the sample, $A^{1\%} 1\text{Cm} = 2592$ (β Carotene extraction coefficient at petroleum ether)

3.9 Determination of β -carotene

β -carotene content of each sample was determined by a slightly modified methods described by Masayasu *et al.*, (1992). At first of prepared a mixture of acetone-hexane with a proportion of 4:6. Then 1gm. sample was taken in a falcon tube with stopper about 15 ml solvent was added to it. Then it was heated for 15 minutes, then it was filtered and measured absorbance at 663, 505 & 453 nm respectively. The β -Carotene content was estimated in mg/100 gm by using the following equation (Igbokwe *et al.*, 2013):

$$\beta\text{-Carotene mg/100 g} = 0.216A_{663} - 0.304A_{505} + 0.452A_{453}$$

3.10 Determination of Total Phenol Content

The total phenol content of each sample was determined according to a slightly modified method by Menon (2014). Firstly, 1g sample was taken in beaker and mixed with 20 ml of methanol: water mixture (60:40 v/v) and filtered through filter paper. The extracted 1ml sample was taken into a test tube and added 0.5ml Folinciocalteu's reagent to it. Then 1ml 7.5% Na_2CO_3 and 8ml of distilled water added and vortexed. Then the test tube was placed in dark for 35 minutes at room temperature. After that the test tube was centrifuged at 4000 rpm for 10 minutes and the supernatant was adjusted to 25 ml and absorbance was read at 725 nm

using a spectrophotometer (UV/VIS, UV-1800). The total phenol content was calculated from a standard curve using Gallic acid and the result was expressed as mg/g.

3.11 Determination of Flavonoid Content

Total flavonoid content was measured by colorimetric method as described by Kim *et al.*, (2003). Firstly, 1gm sample was taken in beaker and mixed with 10ml methanol and filtered through the filter paper. Then the extracted sample (1ml) was taken into a test tube and with the addition of 4ml distilled water. After that 0.3ml NaNO₂ reagent added to the test tube. Meanwhile the test tube was allowed to stand for 5 minutes. Then 0.3ml of AlCl₃, was added and stands for 1 minute. At that moment 2ml NaOH (1M) and water (2.4 ml) were added to test tube and mixed properly. Finally, the sample was centrifuged at 4000 rpm for 5 minutes. After that the supernatant was being used for taking absorbance at 510 nm using a spectrophotometer (UV/VIS, UV-1800). The total flavonoids content was calculated from a standard curve using catechin and the result was expressed as mg/g.

3.12 DPPH radical scavenging capacity

The DPPH assay was used to determine the free radical scavenging capability, with some modifications, as defined by Madhujith and Shahidi (2006). 6 mg DPPH was dissolved in 50mL methanol to create a fresh DPPH solution (about 0.3 mM). In a test tube, the extract (1mL) and DPPH solution (1.9 mL) were combined. After that, the contents were thoroughly mixed and stored at room temperature for 30 minutes. Rewrite A spectrophotometer (UV/VIS, UV-1800) measured the absorbance at 515 nm. The DPPH scavenging behavior was determined using a trolox standard and was expressed in micromoles equal per gram of sample.

3.13 Sensory Evaluation of Bread

The consumer's acceptability of bread incorporated with pumpkin flour and steam pumpkin pulp were evaluated along with the control bread sample. All the samples were labeled with a random code and presented in a randomize order to avoid any bias result (Lawless & Heymann, 2010).

The bread was sliced and packed with label in a high-density polyethylene bag for serving. All the samples were served in a randomize order while the samples were fresh. A panel of 15 untrained panelist from the undergraduate students and some local people who were regular

bread consumers were asked to evaluate different organoleptic attributes of the bread such as taste, flavor, color, texture, and overall acceptance. Before the analysis, panelists were briefed about the sensory attributes. Samples were evaluated for their taste, flavor, texture, appearance, and overall acceptability in a 9-point Hedonic scale. The value of the rating was: Like extremely-9, Like very much 8, Like moderately 7, Like slightly 6, Neither like nor dislike-5, Dislike slightly-4, Dislike moderately-3, Dislike very much 2. Dislike extremely-1.

3.14 Statistical analysis

All the experiments for each sample were done in triplicates. Results are presented as means $\pm$ standard deviation. Statistical analysis was performed (SPSS for windows version 22.0) by one way analysis of variance (ANOVA). Mean comparison were performed using Duncan's multiple range tests for significant effect at $p \leq 0.05$.

CHAPTER IV

RESULTS AND DISCUSSION

As considered to be the good source of vitamin A, pumpkin bread also can be a good source of nutrients and antioxidants. The results of the study explain pumpkin bread in terms of physical and compositional properties and consumer acceptability as a value added product.

4.1 Physical Properties of Bread

The physical parameters that are size related such as bread loaf volume, loaf weight, specific loaf volume, density, crust crumb ratio and firmness were determined for all the bread sample are shown in Table 4.1.

Table 4.1: Physical properties of bread incorporate with different level of pumpkin flour and steam pumpkin pulp

Parameters	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Weight (gm)	152.33±0.54 ^c	154.87±0.65 ^b	158.12±0.75 ^a	152.23±0.19 ^c	152.06±0.84 ^c
Volume (cm ³)	410.75±1.25 ^a	401.02±0.20 ^d	398.18±0.84 ^e	409.07±0.75 ^b	404.75±0.44 ^c
Specific volume (cm ³ /g)	2.69±0.20 ^a	2.61±0.04 ^b	2.52±0.01 ^c	2.69±0.01 ^a	2.66±0.02 ^a
Density (g/cm ³)	0.37±0.00 ^b	0.37±0.02 ^b	0.39±0.00 ^a	0.37±0.00 ^b	0.38±0.00 ^b
Crust/ Crumb ratio	0.21±0.002 ^d	0.22±0.002 ^c	0.24±0.00 ^a	0.23±0.00 ^b	0.24±0.00 ^a
Firmness (kg/s)	1.11±0.09 ^b	1.33±0.08 ^a	1.34±0.03 ^a	1.27±0.09 ^a	1.28±0.03 ^a

Here, each value is expressed as mean ± SD of each sample. Sample 1 (Wheat flour), sample 2 (5% pumpkin flour based bread), sample 3 (7% pumpkin flour based bread), sample 4 (5% steam pumpkin pulp paste based bread) and sample 5 (7% steam pumpkin pulp based bread). Values having the same superscript letter in row are non significant different (P > 0.05).

4.1.1 Weight of Bread

The weight of bread obtained from sample-1, sample-2, sample -3, sample-4, and sample-5 were (152.33 ± 0.54) , (154.87 ± 0.65) , (158.12 ± 0.75) , (152.23 ± 0.19) and (152.06 ± 0.84) g respectively (Table 4.1). Analysis of variance (ANOVA) was carried out for different bread sample. Statistical analysis revealed that there was no significant difference among sample-1, sample-4, and sample-5. But there was a clear significant difference of sample -2, sample -3 with the other three samples. The maximum value was obtained from sample -3: (158.12 ± 0.75) g and the minimum value in sample -5: (152.06 ± 0.84) . Jung sang yoo *et al.*, (2006) also found that the level of increased percentage of pumpkin flour was decreased the bread weight. See *et al.*, (2007) found that the level of increased percentage flour was increased the bread weight.

4.1.2 Volume of Bread

Table 4.1 shows the volume of bread obtained from sample -1, sample -2, sample -3, sample -4 and sample -5 were (410.75 ± 1.25) , (401.02 ± 0.20) , (398.18 ± 0.84) , (409.07 ± 0.75) and (404.75 ± 0.44) cm³ respectively. Analysis variance (ANOVA) was carried out for different bread samples. Statistical analysis revealed that there was significant difference among all the samples ($p < 0.05$). The maximum value obtained from sample-1: (410.75 ± 1.25) cm³ and the minimum value was found in sample -3: (398.18 ± 0.84) cm³. Jung sang yoo *et al.*, (2006) also found that the level of increased percentage of pumpkin flour was decreased the bread volume.

4.1.3 Specific Volume of Bread

Specific volume of bread from sample-1, sample-2, sample-3, sample -4 and sample -5 were obtained (2.69 ± 0.20) , (2.61 ± 0.04) , (2.52 ± 0.01) , (2.69 ± 0.01) and (2.66 ± 0.02) cm³/g respectively (Table 4.1). Statistical analysis revealed that there was no significant difference among sample-1, sample-4, and sample-5 but there was a clear significant difference of sample-2, sample-3 with the other three samples. The maximum value obtained from sample -1: (2.69 ± 0.20) cm³/g and the minimum value in sample -3: (2.52 ± 0.01) cm³/g. See *et al.*, (2007) also found that a higher percentage of pumpkin flour will result in a lower specific volume of breads.

4.1.4 Density of Bread

Table 4.1 shows the density of bread for different levels of pumpkin pulp flour and Steam pumpkin pulp. There were no significant ($p>0.05$) differences among the sample 1,2,4,5 but bread with 7% pumpkin flour (sample-3) showed significantly increased density as compared to the control(sample -1) and other three samples. Feili *et al.*, (2013) was found the increasing trend in density with increasing percentage of Jackfruit rind flour in bread.

4.1.5 Crust Crumb ratio of Bread

From Table 4.1 the result showed the highest crust crumb ratio obtained for sample 3 and 5 followed by sample 1 (0.21 ± 0.00), sample 2 (0.22 ± 0.00), sample 4 (0.23 ± 0.00). There was no significant difference between sample 3 and 5. But sample 1, sample 2, and sample 3 showed significantly difference.

4.1.6 Firmness of Bread

Firmness was found significant difference as compared to sample 1 (control). But there were no significant difference among samples 2, 3, 4, and 5. In this research found that the increased percentage of pumpkin flour and steam pumpkin pulp increased the bread firmness. D. Dojczew *et al.*, (2007) reported that the gluten-bran interaction causes insufficient hydration of gluten protein and starch which increase bread firmness.

4.2 Crust and Crumb Colour of Bread samples

Steam pumpkin pulp has a lighter colour (higher L value) than the pumpkin flour. Pumpkin flour has less red colour (low a value) and increased yellowness (higher b value) than the steam pumpkin pulp. The discoloration of the fresh pumpkin was prevented by steaming the pumpkin pieces. The yellow colour of the pumpkin could have been caused by the carotenoids (Wu and Jin, 1998) as pumpkin is a rich source of β -carotene.

The colour for the bread was significantly affected ($p<0.05$) by the addition of pumpkin flour and steam pumpkin pulp (Table 4.2). The colour of the crust showed a significant decrease ($p<0.05$) in L values of pumpkin flour supplement bread (sample 2 and 3) and steam pumpkin pulp supplement bread (sample 5). There were no significant differences in L value between sample 1 and 4. Steam pumpkin pulp supplement bread was higher L value compared to pumpkin flour supplement bread. But both had decreased L value compared to Control (sample 1).

The colour change occurred from light-brown (control) to darker-brown (7% pumpkin flour bread). This may be because loaves containing additional glucose had a darker crust. This state is ascribed to Maillard browning, which occurs when wheat proteins react with added sugar (Fayle and Gerrard, 2002), and caramelization, which is regulated by water distribution and the reactivity of added sugars and amino acids (Kent and Evers, 1994).

Table 4.2 shows the colour of crust samples significant increased in redness (a value), yellowness (b value) and browning (100-L) of higher percentage of pumpkin flour and steam pulp. Statistical analysis revealed that there were slight difference between sample 1 and sample 4 and also had slightly difference between sample 4 and sample 5 but between in sample 1, 2, 3 and 5 had a clear significant difference in terms of crust colour.

In this research showed that the colour of the crumb sample significantly ($p < 0.05$) increased in redness (a value) and yellowness (b value) but decreased in L value with higher percentage of pumpkin flour and steam pumpkin pulp paste (Table 4.2).

In this present study observed that there was no significant difference in a^* value between sample 3 and 5. Steams pumpkin pulp supplement bread was lower a, b and (100-L) value compared to pumpkin flour supplement bread. But both are increased a, b, and (100-L) value compared to control (sample 1) (Table 4.2). See *et al.*, (2007) found that the colour for the bread was significantly affected ($p < 0.05$) by the addition of pumpkin flour.

Table 4.2 Means Crust and Crumb Color of Bread incorporate with different level of pumpkin flour and steam pumpkin pulp

Parameters		Sample				
		S ₁	S ₂	S ₃	S ₄	S ₅
Crust color	L*	64.54±0.18 ^a	60.33±0.48 ^c	57.61±0.19 ^d	64.12±0.90 ^a	63.43±0.19 ^b
	a*	10.61±0.20 ^d	11.50±0.21 ^c	12.72±0.17 ^a	11.27±0.22 ^{bc}	11.82±0.13 ^b
	b*	31.37±0.44 ^d	33.42±0.21 ^b	35.49±0.25 ^a	31.79±0.17 ^d	32.53±0.25 ^c
	(100-L*)	35.46±0.18 ^d	39.67±0.48 ^b	42.39±0.19 ^a	35.87±0.09 ^d	36.57±0.19 ^c
Crumb color	L*	67.72±0.43 ^a	63.61±0.27 ^d	61.29±0.29 ^e	66.28±0.19 ^b	64.76±0.19 ^c
	a*	2.75±0.16 ^c	3.07±0.13 ^b	4.16±0.12 ^a	2.95±0.07 ^{bc}	3.98±0.12 ^a
	b*	11.25±0.29 ^e	34.57±0.39 ^b	40.38±0.14 ^a	14.96±0.13 ^d	19.25±0.36 ^c
	(100-L*)	32.28±0.43 ^e	36.39±0.27 ^b	38.71±0.29 ^a	33.72±0.19 ^d	35.24±0.19 ^c

Here, each value is expressed as mean $\pm$ SD of each sample. Sample 1 (Wheat flour), sample 2 (5% pumpkin flour based bread), sample 3 (7% pumpkin flour based bread), sample 4 (5% steam pumpkin pulp paste based bread) and sample 5 (7% steam pumpkin pulp based bread). Values having the different superscript letter in row are significant different ($P < 0.05$).

4.3 Proximate Composition of Bread Samples

The proximate composition (moisture, ash, fat, protein, fiber and carbohydrate) content of different bread samples are shown in Table 4.3.

Table 4.3 Proximate composition (%) bread incorporate with different level of pumpkin flour and steam pumpkin pulp

Parameters (%)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Moisture	25.92±0.72 ^a	22.57±0.23 ^d	24.47±0.49 ^b	23.57±0.24 ^c	25.69±0.37 ^a
Ash	1.69±0.03 ^d	1.82±0.02 ^b	1.93±0.04 ^a	1.76±0.02 ^c	1.89±0.02 ^a
Protein	8.87±0.32 ^a	7.47±0.10 ^d	6.94±0.09 ^e	8.47±0.11 ^b	7.98±0.10 ^c
Fat	3.26±0.07 ^d	4.92±0.05 ^a	4.08±0.04 ^b	3.51±0.07 ^c	3.27±0.05 ^d
Crude fiber	0.33±0.02 ^c	0.47±0.06 ^b	0.59±0.04 ^a	0.35±0.03 ^c	0.44±0.02 ^b
Carbohydrate	59.93±0.94 ^c	62.75±0.46 ^a	61.99±0.53 ^{ab}	62.33±0.46 ^a	61.05±0.79 ^{bc}

Here, each value is expressed as mean ± SD of each sample. Sample 1 (Wheat flour), sample 2 (5% pumpkin flour based bread), sample 3 (7% pumpkin flour based bread), sample 4 (5% steam pumpkin pulp paste based bread) and sample 5 (7% steam pumpkin pulp based bread). Values having the different superscript letter in row are significant different ($P < 0.05$).

4.3.1 Moisture content

It is observed from Table 4.3 that sample 2 found 22.57 % of moisture, whereas sample 1, 3, 4, and 5 found 25.92 %, 24.47 %, 23.57 %, and 25.69 % respectively. The lower moisture content of sample 2 justified the long-term storage without deterioration. Statistical analysis revealed that samples 1 and 5 had no significant difference, but samples 2, 3, and 4 were significantly different compared to sample 1 (control). In this research observed that breads moisture content decreased as the proportion of pumpkin in the composite flour shown in Table 4.3 increased. The bread made from only wheat recorded higher moisture contents than all other blends of pumpkin with wheat at different ratios. This result was in agreement with those reported by Temesgen Laelago Ersedo (2019).

4.3.2 Ash Content

The ash content of the bread increased when more pumpkin was added to the composite flour, and samples 1, 2, and 4 were significantly different ($p < 0.05$) from each other, but sample 3 and 5 were not significantly different. However, the ash composition in the supplemented bread was found to be significantly higher as compared to that of the control. The increments of ash in more pumpkin-added bread indicate the presence of more minerals in pumpkin flour

than wheat and have more advantages for consumers to fill their daily mineral requirements by using the developed breads of pumpkin and wheat. Gopalan *et al.*, (1991) reported similar results with the finding that pumpkin-added bakery products are richer in minerals than only wheat products. Pongjanta *et al.*, (2006) also reported that with increasing the level of pumpkin flour, the ash contents were significantly increased in the products.

4.3.3 Fiber Content

Table 4.3 shows that the higher fiber content in samples 2, 3, 4, and 5 bread as compared to sample 1 bread justified the improvement of nutritional value. There were no significant differences between samples 1 and 4, and similarly, between samples 2 and 5. The fiber contents of bread increased when the incorporation of pumpkin flour increased. This result was in agreement with those reported by Temesgen Laelago Ersedo (2019) and See *et al.*, (2007).

4.3.4 Crude Protein

The crude protein content of breads with pumpkin supplements was significantly ($p < 0.05$) lower than sample 1 (control). As the amount of pumpkin flour and steam pumpkin pulp in the composite flour increased, the crude protein level of the breads decreased. This could be because pumpkin-enhanced bread loses more nitrogen than wheat bread during the high-temperature preparation process. Pumpkin is more susceptible to elevated temperatures than wheat in baked products, as reported by Singh *et al.*, (2008). Moreover, Okorie *et al.*, (2012) reported a decrease in crude protein contents when more pumpkin was added to the composite flours of bread production. The assessment of the protein content of breads showed decreases with increasing pumpkin flour, which was similar to the results reported by Gopalan *et al.*, (1991).

4.3.5 Fat Content

Table 4.3 shows there were no significant ($p > 0.05$) differences in fat content between the control (sample 1) and 7% steam pumpkin pulp bread, but an increase in the percentage of pumpkin flour and steam pumpkin pulp showed significantly reduced fat content. See *et al.*, (2007) found that the increased percentage of pumpkin decreased the bread fat content.

4.3.6 Carbohydrate Content

The carbohydrate content of breads made from pumpkin and wheat composite flours was higher than that of only wheat bread. Initially, 0 to 5% of the carbohydrate contents of

pumpkin-added bread were increased compared to control (sample 1), but the carbohydrate contents of bread decreased when more pumpkin was added to wheat flour, 5% to 7%. This could be because wheat flour has more starch granules than pumpkin, resulting in higher carbohydrate content for the control bread. See *et al.*, (2007) reported that substituting pumpkin flour for wheat flour led to a reduction in the total carbohydrate content of breads. Although more pumpkin-added bread products have lower carbohydrate values than wheat bread, the utilization of pumpkin in society can get attention, and it helps as a thickening agent. The results of carbohydrate contents for control bread were slightly different from the reported findings (See *et al.*, 2007; Temesgen Laelago Ersedo, 2019).

4.4 Bioactive Compounds and Antioxidants Activity of bread incorporate with different level of pumpkin flour and steam pumpkin pulp

Table 4.4 Bioactive compounds and antioxidants activity of bread incorporate with different level of pumpkin flour and steam pumpkin pulp

Bioactive compounds	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
TPC (mg/g)	2.30±0.12 ^e	7.63±0.22 ^b	10.48±0.17 ^a	3.74±0.09 ^d	5.49±0.01 ^c
TFC (mg/)	1.89±0.03 ^d	2.35±0.04 ^b	3.03±0.06 ^a	1.91±0.01 ^d	2.10±0.03 ^c
DPPH (μmole/g)	182.37±0.48 ^e	244.24±0.23 ^b	251.43±0.04 ^a	241.29±0.06 ^c	232.02±0.10 ^d
Beta carotene (mg/g)	0.53±0.01 ^e	4.44±0.04 ^b	5.32±0.03 ^a	3.09±0.02 ^d	3.41±0.01 ^c
Total Carotenoids (μg /g)	2.93±0.16 ^e	28.26±0.19 ^b	30.50±0.40 ^a	9.18±0.20 ^d	11.34±0.28 ^c

Here, each value is expressed as mean ± SD of each sample. Sample 1 (Wheat flour), sample 2 (5% pumpkin flour based bread), sample 3 (7% pumpkin flour based bread), sample 4 (5% steam pumpkin pulp paste based bread) and sample 5 (7% steam pumpkin pulp based bread). Values having the different superscript letter in row are significant different ($P < 0.05$).

4.4.1 Total Phenol Content of Bread Samples

Table 4.4 showed the total phenolic contents of bread obtained from sample 1, 2, 3, 4, and 5 were 2.30 mg/g, 7.63 mg/g, 10.48 mg/g, 3.74 mg/g and 5.49 mg/g, respectively. Based on statistical analysis showed that the addition of pumpkin flour and steam pumpkin pulp had a significant effect ($P < 0.05$) on the total phenolic contents of bread. The bread enriched 7% of pumpkin flour presented the highest total phenolic contents 10 mg/g. Pumpkin flour supplement bread were higher total phenolic contents value compared to steam pumpkin pulp supplement bread. According to Que *et al.*, (2008), high temperatures promote the synthesis of phenolic compounds in pumpkin during the drying process. According to Aydin and Gocmen (2015), the process of drying pumpkin flour enhances its overall phenolic content.

Pumpkin flour and steam pumpkin pulp supplement bread had increased total phenolic contents value compared to control (sample 1). So this study were observed that increased level of pumpkin flour and steam pumpkin pulp produced a higher level of total phenolic contents in enriched bread.

According to Wahyono *et al.*, (2019), making bread using varying amounts of pumpkin flour substituted in lieu of wheat flour and found that the bread containing more pumpkin flour had significantly higher total phenolic content. The total phenolic contents of bread buffer extracts and extracts after digestion were measured by Rozylo *et al.*, (2014) after making wheat bread by directly incorporating varying amounts of fresh pumpkin (*Cucurbita maxima*) pulp into wheat flour. They discovered that adding more pumpkin pulp to bread boosted its overall phenolic content.

4.4.2 Total Flavonoid Content of Bread Samples

Numbers of total flavonoid contents analysis of 100% wheat flour bread and bread prepared with different replacement levels of pumpkin flour and steam pumpkin pulp has been given in Table 4.4. Control bread developed with 100% wheat flour presented lowest total flavonoid contents whereas highest total flavonoid contents were observed in bread developed with 7% pumpkin flour. In control bread, total flavonoid contents were found 1.86mg/g, and replacement of 5% steam pumpkin pulp, no significant difference was observed in total flavonoid contents as value was obtained 1.91 mg/g. But 7% replacement of pumpkin pulp caused a significant increase in total flavonoid contents of bread, as the value was 2.10 mg/g. When an increase in replacement level of pumpkin flour from control (0%) to 5% resulted a significant increased in the total flavonoid contents of bread. From these results it was

evident that total flavonoid contents were found increasing significantly with increasing level of pumpkin flour and steam pumpkin pulp.

According to Valenzuela *et al.*, (2014), flavonoids are the most abundant and readily available phenolic compounds in pumpkin. Rozylo *et al.*, (2014) prepared wheat bread by incorporating varying amounts of fresh pumpkin (*Cucurbita maxima*) pulp directly into wheat flour and measured the total flavonoid content of bread buffer extracts and extracts after digestion. The researchers found increase in total flavonoid contents of bread when increased the percentage of pumpkin pulp. Previous research has shown that the addition of pumpkin to various food products increases the total flavonoid content.

4.4.3 Antioxidant Activity (DPPH) of Bread Samples

DPPH free radical activity analysis of control bread and bread prepared with different replacement levels of pumpkin flour and steam pumpkin pulp has been fetched in Table 4.4. Table 4.4 shows the antioxidant activity of bread as evaluated by the test sample's ability to scavenge DPPH radicals. Pumpkin flour and steam pumpkin pulp addition significantly affected ($P < 0.05$) antioxidant activity (DPPH) of enriched bread. From these results it was evident that replacement of pumpkin flour exhibited higher DPPH free radical scavenging activity as compared to control and steam pumpkin pulp and highest antioxidant activity (251.43 $\mu\text{mole/g}$) was presented by pumpkin enriched bread with 7% pumpkin flour. In the contrary, control bread presented the lowest (182.37 $\mu\text{mole/g}$) antioxidant activity. It was also observed that and this DPPH free radical scavenging activity was found increasing significantly with increasing level of pumpkin flour and steam pumpkin pulp.

Pasanda *et al.*, (2019) created composite flours by incorporating pumpkin flour into wheat flour to make biscuits, and they discovered that biscuits made with composite flour including pumpkin flour had a significantly higher antioxidant activity than simple wheat flour biscuits.

Mojarad and Mahdikhani (2020) studied the effect of replacement of pumpkin powder at different levels, on the preparation of biscuits and observed a significant increase in antioxidant activity of biscuits with increased levels of pumpkin flour.

4.4.4 Beta Carotene Content of Bread Samples

Mean values for β -carotene analysis of 100% wheat flour bread and bread prepared with different replacement levels of pumpkin flour and steam pumpkin pulp have been given in Table 4.4. Statistical analysis revealed that among all the sample bread, highest β carotene

content was observed in bread having 7% pumpkin flour (sample 3) and lowest β carotene value was found in control bread (sample 1). Bread developed with steam pumpkin pulp was equipped with lesser β carotene contents, when compared with bread developed with pumpkin flour. There were significant different in each other ($P < 0.05$). However, this β -carotene level was found increasing significantly with increasing level of replacement of pumpkin flour and steam pumpkin.

Results similar to our study were obtained when Pongjanta *et al.*, (2006) determined different carotenoid contents including β carotene in pumpkin added bakery products and observed a significant increase in β carotene by increasing the replacement level of pumpkin powder.

Zaki *et al.*, (2018) incorporated pumpkin powder in wheat flour to develop cake and a significant increase in β carotene of cake was observed with 15% level of pumpkin powder.

4.4.5 Total Carotenoid Contents

Analysis of total carotenoid contents of control bread and bread with different replacement levels of pumpkin flour and steam pumpkin pulp have been presented in Table 4.4. The findings revealed that highest total carotenoid contents were observed in bread having 7% pumpkin flour and lowest were found in control bread. There were a significant different in each other ($P < 0.05$). Steam pumpkin pulp incorporated bread presented relatively lower total carotenoid contents as compared to pumpkin flour incorporated bread. It was also clear from the findings that these total carotenoid contents were found increasing significantly with increasing level of replacement of pumpkin flour and steam pumpkin pulp.

In order to create composite flours, Pasanda *et al.*, (2019) mixed pumpkin flour with wheat flour to create biscuits. They found that the total carotenoid content of the pumpkin flour-incorporated cookies was much higher than that of the plain wheat flour biscuits.

Results similar to this study were obtained when Gurung *et al.*, (2016) performed analysis to check quantity of total carotene (mg/100 g) of biscuits in which wheat flour was replaced by pumpkin puree at different levels.

4.6 Sensory Evaluation

The level of consumers acceptance is often asses by asking consumer the rate how much they like a product overall, using a nine point hedonic scale (Popper and Gibes, 2004). It is known that effective test help to answer whether the product has commercial potential.

The sensory evaluation of different bread samples are shown in Table 4.5

Table 4.5. Sensory evaluation of bread incorporate with different level of pumpkin flour and steam pumpkin pulp

Parameters	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Color	8.33±0.49 ^{ab}	8.67±0.49 ^a	7.73±0.70 ^c	7.93±0.88 ^{bc}	8.60±0.51 ^a
Texture	8.13±0.74 ^{ab}	8.20±0.68 ^{ab}	7.00±0.65 ^c	8.00±0.65 ^b	8.60±0.51 ^a
Taste	8.00±0.76 ^b	8.73±0.46 ^a	6.80±0.68 ^c	8.00±0.85 ^b	8.27±0.46 ^{ab}
Flavour	7.67±0.62 ^b	8.27±0.70 ^a	7.00±0.76 ^c	8.07±0.96 ^{ab}	8.40±0.57 ^a
Overall acceptability	7.80±0.56 ^b	8.60±0.51 ^a	6.93±0.79 ^c	7.87±0.74 ^b	8.73±0.46 ^a

Here, each value is expressed as mean $\pm$ SD of each sample. Sample 1 (Wheat flour), sample 2 (5% pumpkin flour based bread), sample 3 (7% pumpkin flour based bread), sample 4 (5% steam pumpkin pulp paste based bread) and sample 5 (7% steam pumpkin pulp based bread). Values having the same superscript letter in row are not significant different ($P > 0.05$).

Data of sensory evaluation (Table 4.5) indicated that the consumer preferred the color attribute showed that sample 2 achieved highest acceptability. Consumer-oriented panelist texture score of sample 5 values had significantly higher mean scores in texture than the others supplement breads. Sample 1 and 2 had no significant different.

Consumer-oriented panelist taste score of sample 2 values had a significantly ($p < 0.05$) higher mean scores in taste than the others supplement bread ; breads in sample 1, 2 were not significantly different with each other and preferred after sample 5. The taste had obtained lower value from sample 3 compared to others sample values. The judges reported that the sample with a high pumpkin ratio received a low taste score. This could be because pumpkins have stronger smells.

Similar findings were reported by Alam *et al.*, (2007), who found that the taste of the bread decreased as the amount of pumpkin supplementation increased in wheat flour.

The 5% steam pumpkin pulp bread (sample 5) values (8.40) had a significantly ($p < 0.05$) higher mean scores in flavour than the others supplement bread with exception of bread formulated from 5% pumpkin flour and 95% wheat flour (table 5). The flavour was obtained lower value from sample 3 compared to others sample values.

Sensory evaluation results (Table 5) revealed that the overall acceptability of sample 5 (8.73) was highest among the other samples. There was no significant different between sample 2

and 5. This may be due to the better taste than other samples. There was also no significant difference found between the sample 1 and 4 but sample 3 had a clear significant different among with the others sample values.

We found that there were no significant different for texture, taste, flavour and overall acceptability between sample 1 and 4. Similarly there were no significant different for color, texture, taste, flavour and overall acceptability between sample 2 and 5. The sensory evaluation also indicated that sample 2 was the most acceptable bread.

Temesgen Laelago Ersedo (2019) found that increase pumpkin flour percentage in supplement bread decreased the overall acceptability. The study's findings are similarly consistent with a previous study by El-Demery (2011), who found that adding 5% and 10% pumpkin pulp flour resulted in bread with improved acceptability across all quality criteria tested.



Fig 4.5: Graphical representation of sensory attributes (color, flavor, texture, taste and overall acceptance)

CHAPTER V

SUMMARY AND CONCLUSION

Bread is an important, easy staple food found all across the world. There has been a significant amount of effort put into developing composite bread with good sensory characteristics and healthy health advantages. Pumpkin bread is called a protective food because of its nutritive contributions such as vitamins, minerals, pectin, dietary fiber, flavonoids, and polyphenolic antioxidants such as lutein, xanthan, etc. Keeping in view the significance of this vegetable, attempts have been made to evaluate its nutritive composition and develop food products for the benefit of society.

This study revealed that effect of replacing wheat flour with pumpkin powder on the textural and sensory qualities of bakery products. It would be quite beneficial to use the pumpkin powder to make the baked goods. Adding the steam pumpkin pulp directly to the wheat flour gives satisfactory baking results and reduces the cost of production. An increase in the pumpkin pulp fraction (in the range of 0 to 7%) in wheat dough resulted in the production of bread with decreasing loaf volume and increasing firmness. The addition of higher levels of pumpkin pulp caused an unpleasant aroma and taste. This study also showed that enhanced bread items with pumpkin powder had significantly higher levels of β -carotene and other phytochemicals. The substituted products had high nutrient content. The quality and sensory characteristics indicated that a partial replacement of wheat flour in bread with 5% pumpkin pulp and 7% steam pumpkin pulp gave satisfactory results and no significant difference. If most of the nutrients were 7% pumpkin flour, consumer acceptance would be very low. Since most nutrient parameters were 5% pumpkin flour compared to 7% steam pumpkin pulp, so the sensory evaluation also indicated that 5% pumpkin flour bread was the most acceptable bread.

For making it available, to the less affordable consumers who constitute the larger population. For changing this trend, the production of bread made from composite flours with less emphasis on wheat and more attention on locally grown crops have been encouraged by the Food and Agricultural Organization (FAO). The partial inclusion of pumpkin in bread will not only encourage their utilization, but will add value, improve the socio-economic status of local farmers, provide nourishment to malnourished children, and minimize complete dependence on imported wheat flour and save foreign exchange for the country.

In this studies research limitations:

- More sensory studies are needed to understand consumer preferences for different types of pumpkin bread.
- There is a lack of thus research on analyzing mineral content

Future research opportunity

- Investigate natural preservation methods, such as fermentation or the use of natural antimicrobials (e.g., essential oils), to improve shelf stability.
- Exploring the potential of pumpkin peel-derived Biochar and compost as eco-friendly fertilizers.

REFERENCES

- Adams, G. G., Imran, S., Wang, S. Mohammad, A., Kok, S., Gray, D. A., Channell, G A, Moms, G. A. & Harding. S. E. (2011). The hypoglycaemic effect of pumpkins as anti-diabetic and functional medicines. *Food Research International* 44(4), 862-867.
- Adaramoye A., Achem J., Akintayo O., Fafunso A. (2007). Hypolipidemic effect of *Teltairiaoccidentalis* (fluted pumpkin) in rats fed a cholesterol-rich diet. *J Med Food*; 10(2): 330-336.
- Adolfo, A.C. and Michael, H. (2005). Mexican plants with hypoglycaemic effect used in the treatment of diabetes. *Ethnopharmacol* 99: 325 -348.
- Aghaie, S. Nikzad, H. Mahabadi, J.A, Taghizadeh, M., Azami-Tameh, A., Taherian, A., Sajjadian, S.M. and Kamani, M. (2015). "Protective effect of combined pumpkin seed and ginger extracts on sperm characteristics, biochemical parameters and epididymal histology in adult male rats treated with cyclophosphamide". *Anatomical Science International* doi 10. 1007/s12565-015- 0314-x.
- Agricultural Standards 2008. Agricultural Standards ACT., B.E. 2551 (2008). Being the 63rd Year of the Present Reign. Published in the Royal Gazette, Vol. 125, Part 37a, Dated 22nd February 2008.
- Alam, S., Shah, H., Ullah, S., and Riaz, A. (2007). Comparative studies on storage stability of ferrous iron in whole wheat flour and flat bread (naan). *International Journal Food Science and Nutrition*, 58 (1): 54 - 62.
- Al-Rowais, N.A. (2002). Herbal medicine in the treatment of diabetes mellitus. *Saudi Med J*23, 1327-1331.
- Andrade-Cetto, A and Heinrich, M. (2005). Mexican plants with hypoglycaemic effect used in the treatment of diabetes. *J Ethnopharmacol*. 99: 325-348.
- AOAC. (2000). Official methods of analysis of AOAC International (17th ed.). Arlington, TX:Author.
- Arochena, L, Gamez, C., del Pozo, V. and Fernández-Nieto, M. (2012). "Cutaneous allergy at the supermarket." *Journal of Investigational Allergology and Clinical Immunology* <http://www.ncbi.nlm.nih.gov/pubmed/23101191>.

- Association of the Official Analytical Chemists (AOAC). (2016). Official Methods of Analysis of AOAC International 20th Edition, 2016. In 20th ed. Gaithersburg: AOAC.
- Aydin E, Gocmen D. (2015). The influences of drying method and metabisulphite pre-treatment on the color, functional properties and phenolic acids contents and inaccessibility of pumpkin flour. *LWT-Food Science and Technology*, 60: 385-392.
- Bangladesh Bureau of Statistics (BBS) 2014.
- Bangladesh Bureau of Statistics (BBS) 2022.
- Bayat, A., Azizi-Soleiman, F., Heidari-Beni, M, Feizi, A., Iraj, B., Ghiasvand, R. and Askari, G. (2016). "Effect of Cucurbita ficifolia and Probiotic Yogurt Consumption on Blood Glucose, Lipid Profile, and Inflammatory Marker in Type 2 Diabetes". *International Journal of Preventive Medicine*. Doi: 10.4103/2008-7802.175455.
- Caili, F., Huan, S. and Quanhong, L. (2006). A review on pharmacological activities and utilization technologies of pumpkin. *Plant Foods Hum Nutr*. 61: 73-80.
- Carvalho, L. M. J. D., Smiderle, L. D. A. S. M., Carvalho, J. L. V. D., Cardoso, F. D. S.N. and Koblitiz, M. G. B. (2014). Assessment of carotenoids in pumpkins after different home cooking conditions. *Food Science and Technology*. 34: 365-370.
- de Escalada Pla, M.F., Ponce, N.M., Stortz, C.A., Gerschenson, LN. and Rojas, A.M. (2007). Composition and functional properties of enriched fiber products obtained from pumpkin (*Cucurbita moschata* Duchesne ex Poiret). *Swiss Society of Food Science and Technology*. 40: 1176-1185.
- DJutin, K.E. (1991). Pumpkin nutritional properties. *Potatoes and Vegetables*, 3: 25-26 (in Russian).
- Doymaz, I. (2007). The kinetics of forced convective air drying of pumpkin slices. *J. Food Engineering*. 79: 243-248.
- Dutta, D., Chaudhary. U. R. and Chakravarthy, R. (2006). Study on B-carotene retention and Textural changes of pumpkins under different storage conditions. *J. Food Science Technology* 43(5): 549-551.
- El-Demery, M. E. (2011). Evaluation of physicochemical properties of breads fortified with pumpkin (*Cucurbita moschata*) flour. *The 6th Arab and 3rd International Annual*

- Scientific Conference, Faculty of Specific Education, Mansoura University, Mansoura, Egypt, 1, 13–14.
- Elik, A., Yanik, D. K., Istanbulu, Y., Guzelsoy, N. A., Yavuz, A., & Gogus, F. (2019). Strategies to reduce post-harvest losses for fruits and vegetables. *Strategies*, 5(3), 29–39.
- Encyclopedia of Foods. (2004). Encyclopedia of Foods and Their Healing Power: Volume 1. 2004. Education and Health Library Editorial Team (Ed). 2004, ISBN- 0:8472081842.
- Ezeji, C. and Ojimelekwé, P.C. (1993). Effect of fermentation on nutritional quality and functional properties of infant food formulations prepared from pampara groundnut, fruit dip pumpkin and millet seeds. *Plant Foods Hum Nutrition* 44: 267- 276.
- FAOSTAT (2016). Food and agriculture organization of united nations. Statistical Database - FAOSTA.
- Fayle, S.E. and Gerrard, J.A. (2002). Consequences of the maillard reaction in food, p. 9–19. Cambridge, UK: Royal Society of Chemistry.
- Feili R., Wahidu Zzaman, Wan Nadiyah Wan Abdullah, Tajul A. Yang (2013). Physical and Sensory Analysis of High Fiber Bread Incorporated with Jackfruit Rind Flour. *Food Science and Technology* 1(2): 30-36, 2013. DOI: 10.13189/fst.2013.010203.
- Fennema, O., Hui, J. and Karel, M. (2004). Handbook of vegetable preservation and processing. Marcel Dekker, New York.
- Fernandez, Z.F., Guerra, N.B., Diniz, N.M., Salgado, S., Guerra, T.M., Lopes, A.C., Neta, .C. and Padilha, M.R. (1998). "Development of a Milk Beverage Based on Pumpkin lakes." *Archivos Latinoamericanos de Nutricion* <http://www.ncbi.nlm.nih.gov/pubmed/9830496>.
- Foster, R. and Flood, B. (1995). Vegetable Insect Management. Meister Publishing Company, Willoughby, Ohio. ISBN #0-931682-52-5.
- Glew, R.H., Glew, R.S. and Chuang, L.T. (2006). Amino acid, mineral and fatty acid content of pumpkin seeds (*Cucurbitaspp*) and *Cyperus esculentus* nuts in the Republic of Niger. *Plant Foods Hum Nutr.* 61: 51-56.
- Gopalan C, Rama Sastri BV & Balasubramanian SC (1991). Nutritive Value of Indian Foods. National Institute of Nutrition (ICMR), Hyderabad.

- Guine, R. P. F., Pinho, S. and Barroca, M. J. (2011). Study of the convective drying of pumpkin (*Cucurbita maxima*). Journal of Food and Bioproducts Processing,89(4), 422-428. <http://dx.doi.org/10.1016/j.fbp.2010.09.001>.
- Gurung B, Ojha P, Subba D. (2016). Effect of mixing pumpkin puree with wheat flour on physical, nutritional and sensory characteristics of biscuit. Journal of Food Science and Technology Nepal, 9: 85-89.
- Hashim, N. and Pongjata, J. (2000). "Vitamin A Activity of Rice-based Weaning Foods Enriched with Germinated Cowpea Flour, Banana, Pumpkin and Milk Powder Malaysian Journal of Nutrition. <http://www.ncbi.nlm.nih.gov/pubmed/22692393>.
- Hong, J. H., and Lee, W.Y. (2004). Quality characteristics of osmotic dehydrated sweet pumpkin by different drying methods. J. Korean society of Food Science and Nutrition. 33(9): 1573-1579.
- Igbokwe, G.E., Aniakor, G.C. and Anagonye, C.O. (2013). Determination of b-Carotene and vitamin C content of fresh green pepper (*Capsicum annnum*) fresh red pepper (*Capsicum annum*) and fresh tomatoes (*Solanumlycopersicum*) fruits. Bioscientist 1: 89-93.
- Jirapa, P., Normah, H., Zamaliah, M.M., Asmah, R. and Mohamad, K. (2001). "Nutritiona quality of germinated cowpea flour (*Vignaunguiculata*) and its application in home prepared powdered weaning foods" Plant Foods for Human Nutrition. <http://www.ncbi.nlm.nih.gov/pubmed/11442221>
- Jung Sang Yoo, Eun Ju Seog and Jun Ho Lee(2006). Quality Bread as Influenced by Sweet Pumpkin Powder J Food Sci Nutr Vol 11, p 339 343 (2006).
- Kampuse, S., Ozola, L., Straumite, E. and Galoburda, R. (2015). Quality Parameters Of Wheat Bread Enriched With Pumpkin (*Cucurbita moschata*) By-Products. Acta Universitatis Cibiniensis. Series E: Food Technology. 19(2): 3-14.
- Kent, N.L. and Evers, A.D. (1994). Bread made with gluten substitutes. Technology of cereals. p.215. Oxford: Pergamon Press.
- Khan MA, Mahesh C, Vineeta P, Sharma GK, Semwal AD (2019). Pumpkin Flour on the Rheological Characteristics of Wheat Flour and on Biscuit Quality Flours. J Food Process Technol 10:814. doi: 10.35248/2157-7110.19.10.814

- Kim, D. O., Jeong, S. W. and Lee, C. Y. (2003). Antioxidant capacity of phenolic phytochemicals from various cultivars of plums. *Food Chemistry*, 81(3): 321.
- Kim, M.Y., Kim, E.J., Kim, Y.N., Choi, C. and Lee, B.H. (2012). Comparison of the chemical compositions and nutritive values of various pumpkin (*Cucurbitaceae*) species and parts. *Nutrition Research and Practice* 6(1):21-27.
- Kim, N.R., Kim, H.Y., Kim, M.H., Kim, H.M. and Jeong, H.J. (2016). "Improvement of Depressive Behavior by Sweet Pumpkin™ and its Active Compound, B-Carotene." *Life Science*. DOI: 10.1016/j.lfs.2016.01.036.
- Koh, G.A., Scott, J. A., Woodman, R. J., Kim, S. W., Daniels, L.A. and Magarey, A.M. (2014). Maternal Feeding Self-Efficacy and Fruit and Vegetable Intakes in DOI: Study. *Appetite. Infants. Results from the SAIDI* 10.1016/j.appet.2014.06.008.
- Kwon, Y.I., Apostolidis, E. and Kim, Y.C. (2007). Health benefits of traditional com, beans, and pumpkin: in vitro studies for hyperglycemia and hypertension management. *J Med Food*. 10: 266-275.
- La Shell, M.S., Otto, H.F., Whisman, B.A., Waibel, K.H., White, A.A. and Calabria, C.W. (2010). "Allergy to Pumpkin and Crossreactivity to Pollens and Other Foods." *Annals of Allergy, Asthma, and Immunology* DOI: 10.1016/j.anai.2009.11.048
- Lawless, H. T. and Heymann, H. (2010). Chapter 14. Acceptance testing. In *Sensory Evaluation of Food* (pp. 325-347). Springer, New York, NY.
- Lee, C. H., Cho, J. K., Lee, S. J., Koh, W., Park, W. and Kim, C. H. (2002). Enhancing b-carotene content in Asian noodles by adding pumpkin powder. *Cereal Chemistry*, 79(4): 593-595. <http://dx.doi.org/10.1094/CCHEM.2002.79.4.593>.
- Levin, R. (2008). The power of pumpkin in all its parts, feature article. *The food paper*. <http://www.gayot.com/lifestyle/health/features/pumpkin-health-benefits.html>.
- Ma, L. and Lin, X.M. (2010). Effects of lutein and zeaxanthin on aspects of eye health. *Journal of the Science of Food and Agriculture*. 90(1) : 2-12.
- Madhujith, T. and Shahidi, F. (2006). Antioxidants: Extractions, identification, application and efficacy measurement *Journal of Agricultural and Food Chemistry*, 54: 8048-8057.

- Makni, M., Fetoui, H., Gargouri, N.K., Garoui, M. and Zeghal, N. (2011). "Antidiabetic Effect of Flax and Pumpkin Seed Mixture Powder. Effect on Hyperlipidemia and Antioxidant Status in Alloxan Diabetic Rats. Journal of Diabetes and its Complications. 10.1016/j.jdiacomp.2010.09.001.
- Mala, K. S., & Kurian, A. E. (2016). Nutritional composition and antioxidant activity of pumpkin wastes. *International journal of pharmaceutical, chemical & biological sciences*, 6(3).
- Malkanthi, H.H. A. and Umadevi, S. H (2018). Effect of dried pumpkin pulp and seed powder on physical, chemical and sensory properties of biscuits. *Int J Sci Res*, 7, 32-4.
- Mannuramath, M., Yenagi, N. and Orsat, V. (2015). Quality evaluation of little millet (*Panicum miliare*) incorporated functional bread. *Journal of Food Science and Technology*. 52(12): 8357-8363.
- Matus, Z., Molnár, P., & Szabó, L. G. (1993). Main carotenoids in pressed seeds (Cucurbitae semen) of oil pumpkin (Cucurbita pepo convar. pepo var. styriaca). *Acta Pharmaceutica Hungarica*, 63(5), 247-256.
- Menon, L., Majumdar, S. D. and Ravi, U. (2014). Development and analysis of composite flour bread. *Journal of Food Science and Technology*, 52(7): 4156- 4165.
- Mojarad LS, Mahdikhani S. (2020). The study effect of using pumpkin flour on the preparation of diet biscuits and its sensory and physicochemical properties. *Food Science and Technology*, 17: 31-46.
- Murkovic, M., Mulleder, U. and Neunteufl, H. (2002). Carotenoid content in different varieties of pumpkins. *Food Composit Anal*. 15: 633-8.
- Nakazibwe, I., Wangalwa. R., Olet, E.A. and Kagoro, G.R. (2019). Local knowledge of pumpkin production, performance and utilization systems for value addition avenues from selected agro-ecological zones of Uganda. *African Journal of Agricultural Research*, 14(32):15091519.
- Nema, P. K. (2004). Hot air and infrared drying of carrot (*Daucascarota*). *Beverage and Food World*. March: 31-32.

- Okorie, S. U. and Onyeneke, E. N. (2012). Production and quality evaluation of baked cookies from blend of pumpkin and wheat flour. *Natural and Applied Sciences*, volume 3 No. 2. Imo State University, Owerri, NIGERIA.
- Ondigi, A.N., Toili, W.W., Afisihi, S.M. and Stanley, O.O. (2008). Comparative analysis of production practices and utilization of pumpkins (*Cucurbita pepo* and *Cucurbita maxima*) by smallholder farmers in the Lake Victoria Basin, East Africa. *Afr. J. Environ. Sci. Technol.* 2(9): 296-304.
- Paris, H.S. (2010). History of the Cultivar-Groups of *Cucurbita pepo*. *Horticultural Reviews* 25 (November): pp. 71-170.
- Pasanda IM, Suryanto E, Djarkasi G. (2019). Formulation of Composite Flour with Antioxidant from Goroho Plantain Flour (*Musa acuminata*, sp.) and Yellow Pumpkin Flour (*Cucurbita moschata*) and Its Application on Biscuit Making. *Indonesian Food and Nutrition Progress*, 16: 15-21.
- Pereira, M.A., Ramos, H.A., Krolow, R.C.A., Santos, R. and Gularte, A. M. (2020). Physicochemical characterization, carotenoid content and protein digestibility of pumpkin access flours for food application. *Food Science and Technology*. ISSN 0101-2061 (Print), ISSN 1678-457X (Online).
- Pongjanta J, Naulbunrang A, Kawngdang S, Manon T, Thepjaikat T. (2006). Utilization of pumpkin powder in bakery products. *Journal of Science and Technology*, 28(1):71-9.
- Potter, T.S. and Hashimoto, K. (1994). "Butternut Squash (*Cucurbita moschata*) Dermatitis." *Contact Dermatitis*. <http://www.ncbi.nlm.nih.gov/pubmed/8187500>.
- Provesi, J.G., Dias, C.O. and Amante, E.R. (2011). Changes in carotenoids during processing and storage of pumpkin puree. *Food Chemistry*. 128(1): 195-202.
- Que F, Mao L, Fang X, Wu T. (2008). Comparison of hot air drying and freeze drying on the physicochemical properties and antioxidant activities of pumpkin (*Cucurbita moschata* Duch.) flours. *International journal of food science and technology*, 43: 1195-1201.
- Rak, A. E., Nasir, S. N. A. M., Nor, M. M., Han, D. K., Appalasamy, S., Abdullah, F. and Ghazi, R. M. (2020). Proximate analysis and fatty acid of *Corbicula fluminea* (*C. fluminea*) tissue in Kelantan, Malaysia. *Environmental Science and Pollution Research*, 27(20), 24772-24785.

- Rosales-Juárez, M., González-Mendoza, B., Loper-Guel, E. C., Lozano-Bautista, F., Chanona-Pérez, J., Gutierrez-Lopez, G and Calderón-Dominguez, G. (2008). Changes on dough rheological characteristics and bread quality as a result of the addition of germinated and non-germinated soybean flour. *Food and Bioprocess Technology*, 1(2): 152-160.
- Rozyło R, Gawlik-Dziki U, Dziki D, Jakubczyk A, Karas M, and Rozyło K. (2014). Wheat bread with pumpkin (*Cucurbita maxima* L.) pulp as a functional food product. *Food technology and biotechnology*, 52: 430-438.
- See, E.F., Wan Nadiah and W.A. and Noor Aziah, A.A. (2006). Physico-Chemical and Sensory Evaluation of Breads Supplemented with Pumpkin Flour. *ASEAN Food Journal* 14 (2): 123-130 (2007).
- Sharma, D., Rawat, I. and Goel, H.C. (2015). "Anticancer and Anti-Inflammatory Activities of Some Dietary Cucurbits." *Indian Journal of Experimental Biology*. <http://www.ncbi.nlm.nih.gov/pubmed/26011982>
- Silva, K. S., Caetano, L. C., Garcia, C. C., Romero, J. T., Santos, A. B. and Mauro, M.A. (2011). Osmotic dehydration process for low temperature blanched pumpkin. *Journal of Food Engineering*, 105(1): 56-64.
- Singh, S, Riar, C. S. and Saxena, D. C. (2008). Effect of incorporating roots and sweet potato flour to wheat flour on the quality characteristics of cookies. *African Journal of Food Science*, 2: 065-072.
- Stevenson, G., Eller, J, Wang. L. Jane, L., Wang, T. and Inglett, E. (2007). Oil and tocopherol content and composition of pumpkin seed oil in 12 cultivars. *J. Agric. Food Chem.* 55(10): 4005-4013.
- Sudipta, D. and Soumitra, B. (2015). Production of Pumpkin Powder and its Utilization in bakery Products Development : A Review. *International Journal of Research in Engineering and Technology*. 4(5): 478-480.
- Tarrazo-Antelo, A.M., Ruano-Ravina, A., AbalArca, J. and Barros-Dios, J.M. (2014). "Fruit and Vegetable Consumption and Lung Cancer Risk: a Case-Control Study in Galicia, Spain." *Nutrition and Cancer*. DOI: 10.1080/01635581.2014.936951.
- Temesgen Laelago Ersedo (2019). Chemical and Sensory Evaluations of Wheat (*Triticumaestivum* L.) Bread Enriched with Pumpkin (*Cucurbita maxima* L.) Flour.

- International Journal of Food Science and Nutrition Engineering 2019, 9(1): 24-30
DOI: 10.5923/j.food.20190901.03.
- Teugwa, C.M., Boudjeko, T., Tchinda, B.T., Mejiato, P.C. and Zofou, D. (2013). "Anti-Hyperglycaemic Globulins from Selected Cucurbitaceae Seeds Used as Antidiabetic Medicinal Plants in Africa." BMC Complementary and Alternative Medicine. DOI: 10.1186/1472-6882-13-63.
- Toan, V.N. and Thuy, T.T.N. (2018). Production of high-quality flour and the made biscuits from Pumpkin. International Journal of Food Science and Nutrition; 3(5): 157-166.
- Usha, R., Lakshmi, M. and Ranjani, M. (2010). Nutritional, sensory and physical analysis of pumpkin flour incorporated into weaning mix. Malaysian Journal of nutrition, 16(3): 379-387.
- Valenzuela GM, Soro AS, Tauguinás AL, Gruszycki MR, Cravzov AL, Giménez MC, Wirth A. (2014). Evaluation polyphenol content and antioxidant activity in extracts of *Cucurbita* spp. Open Access Library Journal, 1: 1-6.
- Wahyono, A., Dewi, A. C., Oktavia, S., Jamilah, S., & Kang, W. W. (2020). Antioxidant activity and total phenolic contents of bread enriched with pumpkin flour. In IOP Conference Series: Earth and Environmental Science (Vol. 411, No. 1, p. 012049). IOP Publishing.
- Ward, D. and Ainsworth, P. (1998). The development of a nutritious low cost weaning food for Kenya infants. African Journal of health sciences, 5(1-2), 89-95.
- Wu, J.R. and Jin, T.M. (1998). Determination of beta-carotene in different pumpkin varieties by HPLC. Acta Agri. Boreali Sinica, 13: 141-144.
- Xia, T. and Wang, Q. (2006). Antihyperglycemic effect of *Cucurbita ficifolia* fruit extract in streptozotocin-induced diabetic rats. Fitoterapia. 77(7-8): 530-533.
- Zaki NL, Sheir MA and Sakr AM. (2018). The efficiency of some natural beta-carotene sources in improving the quality of the cake. Sciences, 8: 1437-1450.