FORMULATION AND CULINARY APPLICATION OF WOMEN - FOCUSED HEALTH SUPPLEMENT MIX

ST.TERESA'S COLLEGE
(AUTONOMOUS)

PROJECT SUBMITTED

In Partial Fulfilment of the Requirement for the Award of the degree of

B.Sc. NUTRITION AND DIETETICS

BY

AFNA FATHIM S	**SB22ND002**
CHANDINI SIVASOORYA	**SB22ND013**
GAYATHRI D	**SB22ND021**
NADA NADEER	**SB22ND031**
PARVATHY B	**SB22ND036**
SANIKA SURESH	**SB22ND041**
SWATHI	**SB22ND045**

DEPARTMENT OF CLINICAL NUTRITION AND DIETETICS

ST. TERESA 'S COLLEGE (AUTONOMOUS)

ERNAKULAM

APRIL 2025

CERTIFIED AS BONAFIDE RESEARCH WORK

Signature of Internal Examiner

ST. TERESA'S COLLEGE (AUTONOMOUS) DEPT. OF CLINICAL NUTRITION AND DIETETICS ERNAKULAM

21/5/25

Signature of External Examiner

CERTIFICATE

We hereby certify that the project entitled **"Formulation And Culinary Application of Women - Focused Health Supplement Mix"** submitted in partial fulfilment of the requirement for the award of the degree of B.Sc. Nutrition and Dietetics is a record of original work done by Afna Fathim S, Chandini Sivasoorya, Gayathri D, Nada Nadeer, Parvathy B, Sanika Suresh, Swathi during the period of the study under my guidance and supervision.

Signature of HOD

Ms. Surya M Kottaram
Head, Assistant Professor
Department of Clinical Nutrition and Dietetics
St. Teresa's College (Autonomous)
Ernakulam

Signature of Research Guide

Dr. Samja Sabu
Assistant Professor
Department of Clinical Nutrition and Dietetics
St. Teresa's College (Autonomous)
Ernakulam

DECLARATION

We hereby declare that the project entitled **"FORMULATION AND CULINARY APPLICATION OF WOMEN–FOCUSED HEALTH SUPPLEMENT MIX"** submitted in partial fulfilment of the requirement for the award of the degree of B.Sc. Nutrition and Dietetics is a record of original research work done by Afna Fathim S, Chandini Sivasoorya, Gayathri D, Nada Nadeer, Parvathy B, Sanika Suresh, Swathi under the supervision and guidance of **Dr. Samja Sabu**, Assistant Professor, Department of Clinical Nutrition and Dietetics, Women's Study Centre, St. Teresa's College (Autonomous), Ernakulam and has not been submitted in part or full of any other degree/diploma/fellowship or the similar titles to any candidate of any other university.

Place : Ernakulam

Date : 02 – 05 – 2025

Afna Fathim S

Chandini Sivasoorya

Gayathri D

Nada Nadeer

Parvathy B

Sanika Suresh

Swathi

ACKNOWLEDGEMENT

First and foremost, We would like to praise and thank God, the almighty, who has granted me a countless blessings, knowledge, and opportunity to complete this thesis.

We are sincerely grateful to Rev. Sr. Nilima CSST, Provincial Superior and Manger Manager , Rev. Sr. Francis Ann CSST, Director, Dr. Alphonsa Vijaya Joseph, Principal, St. Teresa's College (Autonomous), Ernakulam and Dr. Kala M.S, Dean of Selffinancing Stream, for granting me the opportunity to undertake this project and for fostering an environment of academic excellence.

We express our sincere thanks to Dr. Lekha Sreenivas, coordinator of Women's Study Centre, St. Teresa's College, Ernakulam for her constant encouragement and advice.

We would love to express our sincere gratitude to Ms. Surya M Kottaram, Head of the Department for the constant support and advice.

We are deeply indebted to our guide Dr. Samja Sabu, Assistant Professor, Department of Clinical Nutrition and Dietetics, for her constant guidance and supervision and for providing the necessary information regarding the thesis activities. Her insightful feedback pushed us to sharpen our thinking and brought our work to a higher level.

We take this opportunity to express gratitude to all of the Department faculty of Clinical Nutrition and Dietetics for their valuable advices. Their detailed and constructive comments, ideas, and concepts had a remarkable influence on my entire thesis work.

We are forever grateful to our beloved family members, friends and all our well-wishers for their timely help and support.

LIST OF CONTENTS

LIST OF TABLES

LIST OF PLATES

LIST OF FIGURES

1. INTRODUCTION

"A Healthy Outside Starts From The Inside"

- Robert Urich

Menstruation (Artava) is the monthly shedding of the lining of a woman's uterus (more commonly known as the womb). The menstrual blood, which is partly blood and partly tissue from the inside of the uterus flows from uterus through the cervix and out of the body through the vagina. According to the ancient ayurvedic text, the Charaka Samhita, the menstrual cycle should be regular and between twenty-seven and thirty days long. The cycle should last between three and seven days and should be continuous rather than stopping and starting. The average age of menarche (first onset of menstruation in girls) in females is 12 years. However, girls can begin menstruating as early as 8 years of age or as late as 16 years of age. Women stop menstruating at menopause, which occurs at about the age of 50. Menopause is a condition when a woman stops menstruating and production of eggs. The term Menopause stands for one year without menstrual cycle or periods, and after this time woman will no longer become pregnant (Sherwood, 2015).

In females the menstrual cycle is referred as hormone controlled. Its timing of onset is controlled by the hypothalamus, pituitary gland as well as the ovaries. Two Hormones progesterone and estrogen are produced in the ovaries. The balance of all these hormones regulates the menstrual cycle. The menstrual cycle consists of three phases as follicular/proliferative phase, ovulatory phase, and luteal/secretory phase (Sharma, 2014).

Irregular menstrual cycles are observed in approximately 50% of women in India. Irregular cycles are a major cause of concern for women, which if untreated, often lead to other health issues such as infertility, PCOS (polycystic ovarian syndrome), anemia and other several gynecological issues. Simultaneously, various studies reported that over 20% of Indian women suffer from PCOS. Irregular menstrual cycles are treated by hormonal tablets that are used for hormonal therapy or birth control pills are prescribed. Women with irregular menstrual cycles caused due to fibroids, polyps, cysts, PCOS or endometriosis were are treated accordingly. Women suffer from various menstrual disorders (Artavadushti) in her life span. Artavadushti

(menstrual disorders) refers to the health conditions that affect a woman's normal menstrual cycle. From heavy periods to irregular periods, women can experience many different gynecological issues relating to their monthly cycle. Doctors treat or manage menstrual disorders based on the cause and the signs and symptoms being experienced by the patient. The menstrual cycle is accompanied with pain due to constriction of blood vessels. The menstrual cycle comprises heavy bleeding associated with swollen breasts (National Health Portal of India, 2018).

Ashoka flower

As per Ayurveda, a remarkable remedy for such gynecological issues is Ashoka (*Saraca indica* or *Saraca asoca(Roxb*.), which is extensively used in bleeding disorders in women throughout her active reproductive period. Severe Menstrual period-related symptoms such as cramps, tiredness, and bloating of the various symptoms, over 47% users reported having cramps. Around 49% women reported being tired and 28% women complained of being bloated during their cycles. Mood swings are observed at some point in menstrual cycles. The Ayurvedic treatise, the Charka Samhita (100 A.D.), in which Asoka is recommended in formulations for the management of pain with relation to uterus (gynecological). All the plant parts of Ashoka tree are considered to contain medicinal properties. It possesses various activities such as analgesic, antipyretic, anthelminthic, antidiabetic, fungitoxic, larvicidal activity, anti-microbial activity, CNS (Central Nervous System) depressant activity, antiulcer activity. Ashoka, known as queen of herbs, belonging to the family *Caesalpinioideae*, is one of the most important herbs. The plant possesses several medicinal values and widely used in Unani and Ayurvedic system of medicine to treat number of diseases and conditions like treatment for pain, improves complexion of the body, improves digestion and assimilation, alleviates excessive thirst, to kills all infectious agents, in blood disease and inflammation. But the characteristic property of *Saraca asoca* is its significant potential of maintaining female reproductive health. It is extensively used in bleeding disorders in women throughout her active reproductive period (Rasekar and Shahi, 2022).

Ashoka means no grief in Sanskrit language. So, it is also called as "friend of women" because of its significant potential of maintaining female reproductive health. It has stimulating effect on endometrial and ovarian tissue. This medicinal plant is most commonly used in all the traditional systems of medicine like Ayurveda, Siddha, Yunani, and Folk system. Ashoka is

a rich source of secondary metabolites like glycosides, flavonoids, tannins, steroids, volatile oil, steroidal glycosides, polyphenols etc. Ashoka is associated with a wide range of therapeutic properties. In Ayurveda, Ashoka is used to treat a variety of diseases. It is used in various traditional herbal formulations, which are of great importance from a medicinal perspective (Bisht *et al.,* 2017).

Asokarishtam (Ashokarishta) is an effective well recommended herbal formulation used since ancient times. It's a Ayurvedic medicine (Uterine Tonic) used for the treatment of all gynecological disorders like premenstrual syndrome (PMS), post-menopausal syndromes, leucorrhea, amenorrhea, oligomenorrhea and dysmenorrhea. It is beneficial in menstrual problems and their associated symptoms like painful and heavy bleeding, mood swings, depression. For the effective management of irregular periods, the decoction made from the bark of Ashoka is used. It helps to treat various gynecological and menstrual problems in women such as heavy, irregular and painful periods. As per the report of a case study (Sushma & Yadava, 2021), Ashokarishta has the potential to cure ovarian cyst. Ashokaghrita is effective against infertility. It can be used orally in the form of Churna/powder or capsule, twice daily after meals. In this way women get relief from abdominal pain and spasms. It acts as an analgesic agent. It is also used in dysentery, backache, stomachache, headache, debility, etc.

During the menstrual cycle, body undergoes many physiological and hormonal changes. Therefore, in additional to herbal remedies the seed cycling/seed rotation diet is a new trend that claims to be effective for female menstrual dysfunctions such as irregular menstruation, menstrual cramps, infertility, menopausal symptoms (hot flashes, fatigue, etc.), and PCOS. The higher prevalence of hormonal imbalance in women is a contributing factor to all of these menstrual dysfunctions. The major hormones that control menstruation in females include progesterone, estrogen, luteinizing hormone (LH), and follicular stimulating hormone (FSH), and a simple imbalance in their concentration is the root cause of a variety of menstrual problems. The practice of eating specific seeds during the two main phases of the menstrual cycle (follicular and luteal) to promote a healthy balance of estrogen and progesterone levels in women is known as the seed rotation diet. This involves the consumption of seeds like sunflower seeds, pumpkin seeds and chia seeds during different phases of menstrual cycle (Saxena *et al.,* 2024).

Pumpkin seeds

Pumpkin seeds *(Cucurbita maxima)*, also known as pepita in North America, is highly nutritious and beneficial for the body. It is also called as little seed of squash. They are included among the edible parts of the pumpkin. They belong to the family *Cucurbitaceae* as they are extracted from pumpkins. As nutritious as they are, they provide a lot of health benefits. It has an outer shell that is highly rich in fiber. They are highly nourishing and are packed full of antioxidants. The major components recognized to provide health benefits are omega-3, omega 6 fatty acids, fiber, antioxidants, vitamins and minerals. They provide a substantial quantity of healthy fats, magnesium and zinc. They are known to improve heart and prostate health, and it protects against certain cancers. They are high in minerals, including manganese and vitamin K, both of which aid in wound healing. They are also high in zinc, which helps to increase immunity. Since ages, pumpkin seeds have been used in folk medicine to treat kidney, bladder, and prostate problems. Due to its high nutritional and health protective values and also for pharmacological activities such as antidiabetic, antifungal, antibacterial and antiinflammation and antioxidant effects, pumpkin seed has increasing considerable attention (Nkosi *et al.,* 2020).

Pumpkin seeds are known as nutritional powerhouses, as these seeds are excellent nutrient sources responsible for fighting diseases and acts as weapon for fighting diseases such as arthritis, inflammation, prostate cancer etc. They were generally regarded as a waste but now they can play important role in food by nutritional aspects. They can be consumed regularly without causing any side effects on human health (Yadav *et al.,* 2010).

Pumpkin seeds contain phytoestrogen. Phytoestrogens are those compounds that have estrogenic-like effects over the body. The oil of pumpkin seeds has proved to contain a high percentage of phytoestrogens, minerals (Zn, Mg, Cu, Mn, Fe, P) and sterols. Phytoestrogens as the name suggest mimic the function of estrogen due to their ability to bind with the estrogen receptors. These are polyphenols present in plant extracts and are present in pumpkin seeds at a concentration of 265 mg/100g of seeds (Akbal *et al.,* 2020). Rodent model studies have proven the estrogenic activities of pumpkin seeds such as regulating lipid metabolism, bone remodeling, and mammary gland and uterus epithelial cell development. Moreover, the zinc in pumpkin seeds supports progesterone production towards the progesterone rise in the second phase of the menstrual cycle. The mineral zinc promotes the formation of the corpus luteum,

which is responsible for producing progesterone and stimulates the uterus to thicken in preparation for potential implantation (Nawirska-Olszańska *et al*., 2013).

Seeds are high in Zinc, especially pumpkin seeds and sesame seeds. Zinc is essential for hormone production, ovulation, regulating cycles, and making progesterone for pregnancy. Zinc supplementation reduces cramps. The pill depletes zinc, and copper IUDs can cause imbalances in zinc levels. Zinc has been shown to improve complaints related to our periods including reducing pain, PMS, acne, irregular cycles, improving mood, and hair loss. In fact, one study showed that zinc was as effective as the pill at reducing painful periods. The study from the International Journal of Reproductive Bio-Medicine, says when Zinc is supplemented before your period, it reduces the intensity of cramping (Parsapure *et al.,* 2013).

Sunflower seeds

Sunflower seeds have also grabbed attention due to the substantial contribution in health. Sunflower plant *(Helianthus annuus)*, a leading oil seed crop which is cultivated primarily for its seeds, ranks second for edible oil production globally. Sunflowers are cultivated globally for its oil and protein content predominantly. Proteins present in sunflower seeds have favorable amino acid distribution. Also in addition, tocopherols, minerals, and vitamins are provided by sunflower seeds in substantial amounts. Sunflower seeds are a rich source of two vital micronutrients such as vitamin E and selenium. Vitamin E can elevate progesterone production, while selenium helps in the detoxification of excess estrogen from the liver. Both of these are believed to be crucial for menstrual health (Mahapatra *et al.,* 2023).

Vitamin E helps to support the production of progesterone. It helps to make the uterine lining thicker. Which improves pregnancy rates for women with unexplained infertility. Vitamin E improves the development of embryos in animal studies. Vitamin E sunflower seeds proved to improve PMS in some human studies. Dadkhah *et al*., (2016) conducted a randomized double blind, controlled trial with 86 women facing PMS. In that, 100 mg vitamin E supplementations were provided to the women for 2 months. After the study, the mean score of the syndrome significantly decreased.

Selenium detoxes excess estrogens out of the body by supporting the liver, especially during the luteal phase when estrogen levels should naturally be declining so progesterone can take over. Selenium enhances the production of all female hormones needed for a regular cycle.

Selenium creates a healthy environment for the egg, and plays a critical role as an antioxidant, it is absolutely essential for ovarian health.

Chia seeds

Scientifically known as *Salvia hispanica L.*, originated from a summer herbaceous plant that belongs to the *Lamiaceae* (mint) family currently are becoming more popular in the food industry as a "novel food", as ingredient of functional food (FOSHU) and dietary supplements. The shape of the chia seed is flat and oval. The color of the seed coat varies from grey, black- and white-spotted, which are slightly different from each other. For the chia seed coat, it comes with mucilage, which aids in the protection of the seed nutrients in the entirety, as well as participating in the food's water retention process. Mexico is recognized as the largest producer of Chia in the world (Mohd Ali *et al.,* 2012).

Recently, there has been tremendous growth in the use of chia seeds because of their associated medicinal as well as high nutritional values. Chia seeds exist as an ancient food, providing balanced amounts of minerals, high content of antioxidants, proteins with amino acids in excellent quantity, high omega-3/-6 fatty acids, and insoluble fiber. Thus, this seed forms a crucial source of α-linoleic, which is among the most beneficial ω-3 fatty acids. Recent studies confirmed that chia seeds show cardioprotective, hypotensive, antidiabetic, antioxidant, anti-inflammatory, hypolipemic, neuroprotective, and hepatoprotective properties. The use of chia seeds is safe and not associated with side effects (Coorey *et al.,* 2014).

Currently, chia seeds are described by scientists as the golden seed of the 21st century. Chia seeds are characterized by a unique chemical composition with a high nutritional value. The caloric value per 100 g of dry chia seeds is 486 kcal. Chia seeds are rich in fat (30–33%), protein (15–25%), and carbohydrates (26–41%), including dietary fiber (18–30%), as well as vitamins (A, E, C, B1, B2, B3), bio elements (calcium, phosphorus, potassium, magnesium). The protein content of chia seeds can range from 16% to 26%, based on growing conditions, temperature, and humidity. Amino acids present in chia seeds are extremely important for maintaining human metabolic activity. Being the main building block in the human body for blood, bones, cartilage, muscles, and skin, protein must be sufficient in the human body for all these processes to take place. chia seeds have the potential to correct and prevent protein energy malnutrition (Pizarro *et al.,* 2021).

Chia seeds oil has been reported to contain an excessive quantity of fatty acids, especially polyunsaturated fatty acids (PUFA). Among the common PUFAs of great interest to researchers are omega -3 fatty acids, which have remarkable nutritional benefits. Omega 3 fatty acids from marine or plant sources by humans reduces the risk of cardiovascular diseases and it have also got anti-inflammatory properties which can help reduce menstrual cramps and discomfort. Chia seeds are rich in carbohydrates and dietary fiber. The main purpose of the dietary fiber in the human body is to retain healthy digestive system in the human body. It therefore prevents constipation and reduces bloating caused by hormonal changes (Grancieri *et al.,* 2019).

Vitamins and minerals present in chia seeds are involved in hormone production which helps in regulating the menstrual cycles. Calcium present builds and protects bones and teeth and also is involved in muscle relaxation and contractions. Magnesium on other hand helps to relieve muscle tension and mood swings during menstruation. During menstruation blood loss occurs causing depletion of iron stores. Thus, iron in chia seed helps to replenish iron and prevent anemia or fatigue. Chia seeds can form a gelatinous mass when soaked in water. This is due to the occurrence of a large amount of mucilages and gums, which make the seeds strongly hydrophilic and thus capable of absorbing several times their weight in liquids such as water that can absorb up to 12 times its weight. This helps the body retain hydration, which helps to reduce bloating and fatigue. Chia seeds contain high antioxidants so that they are effective in reducing oxidative stress. Also, Weight controlling, Chia seeds are loaded in natural or artificial substances and nitrogenous matter, which can aid in assisting a feeling of satiety and decrease calories consumption. Chia seeds may positively affect insulin resistance which can control blood sugar levels which may fluctuate due to hormone changes. In addition, recent scientific research indicates that chia seeds can prevent the formation of kidney stones and exhibit neuroprotective and hepatoprotective properties (Grancieri *et al.,* 2019).

In short, it can be said that the Ashoka flower and seeds helps in developing a functional product which aims in promoting menstrual wellness. The present study is an attempt to development a women health focused health mix by combining these natural ingredients and its incorporation in other recipes.

NEED OF THE STUDY:

Ashoka flower and seeds powder have huge benefits on menstrual health. Nutritional and therapeutic benefits are more needed to explore. Since the incidence of PCOD, PCOS and its related complications and infertility cases are increasing in an alarming rate today, the present study is significant in current scenario.

OBJECTIVE OF THE STUDY:

- **To develop a women health focused health mix with Ashoka flower as major and evaluate the amount of selected nutrients.**
- **To incorporate the health mix into selected recipes.**
- **Evaluate the acceptability and composition of selected nutrients of health mix incorporated recipes.**

2. REVIEW OF LITERATURE

The literature study pertaining to the study **"Formulation and Culinary Application of Women – Focused Health Supplement Mix"** were under the following headings.

2.1 Physical properties

2.1.1 Physical properties of Ashoka flower

2.1.2 Physical properties of Sunflower seeds

2.1.3 Physical properties of Pumpkin seeds

2.1.4 Physical properties of Chia seeds

2.2 Chemical properties

2.2.1 Chemical properties of Ashoka flower

2.2.2 Chemical properties of Sunflower seeds

2.2.3 Chemical properties of Pumpkin seeds

2.2.4 Chemical properties of Chia seeds

2.3 Nutritional composition

2.3.1 Nutritional composition of Ashoka flower

2.3.2 Nutritional composition of Sunflower seeds

2.3.3 Nutritional composition of Pumpkin seeds

2.3.4 Nutritional composition of Chia seeds

2.4 Therapeutic properties

2.4.1 Therapeutic Properties of Ashoka flower

2.4.2 Therapeutic Properties of Sunflower seeds

2.4.3 Therapeutic Properties of Pumpkin seeds

2.4.4 Therapeutic Properties of Chia seeds

2.1 Physical Properties

Literature study for the physical properties of Ashoka flower, Pumpkin seeds, Sunflower seeds and Chia seeds were carried out.

2.1.1 Ashoka Flower

The plant Ashoka (Saraca asoca Roxb.) is one such multi-dimensional medicine found in the Moodubidire Range of Dakshina Kannada District. It is one among the important plants of Indian system of Medicine known for its numerous pharmacological activities. The plant Ashoka is mentioned in classics for its utility in various gynaecological disorders by using bark as its useful part. But, in the folklore practice apart from its utility in gynaecological disorders, the flowers in the form of milk shake or syrup or tambuli (food preparation) are beneficial in gastritis, tender leaves in acne vulgaris, stem in case of skin diseases and roots in blackish discolouration on face (Saraswathi and Padyana, 2021).

Saraca indica or *Saraca asoca* is a small evergreen tree 7-10 cm high. It occurs the up to the Altitude 750 meters. Flowers are Polygamous apetalous, Yellowish orange turning to scarlet, in short laterally placed corymbose, axillary panicles, bract Small, deciduous, calyx petaloid. Seeds are 4-8, ellipsoid-oblong and compressed. Leaves are parpinnate 15-20 cm long and the leaflets 6-12, oblong and rigidly sub-coriaceous. Leaves are narrowly lanceolate, cork like at the base and with a shot Pestistipules are intra-petiolar and completely united. The bark is dark brown or grey or almost Black with warty surface. Stem bark are rough and uneven due to the presence of rounded or Projecting lenticles. Bark channeled, smooth with circular lenticles and traversely ridged, sometimes cracked. Fracture splinting exposing striated surface, a thin whitish and continuous Layer is seen beneath the cork leaver. The flowers are fragrant (Smith, 2025).

2.1.2 Sunflower Seeds

Sunflower (*Helianthus annuus L.*) is one of the world's most important oilseed crops. Sunflower kernel and its defatted meal have several advantages over other oilseed meal as human protein food, because of the absence of anti-nutritional or toxic factors, flavour and of its high digestibility and biological value. Sunflower seeds are excellent source of dietary fiber, protein, vitamin E, B vitamins, and minerals such as potassium, magnesium, iron, phosphorus, selenium, calcium and zinc (Gupta and Das , 2016).

The physical properties of sunflower seeds (*Helianthus annuus L.)* were determined as a function of moisture content in the range of 10.06-27.06% dry basis (d.b.). The average length, width and thickness were 7.79, 7.12 and 4.18 mm, at a moisture content of 10.06% d.b., respectively. In the above moisture range, the arithmetic and geometric mean diameters increased from 6.37 to 8.05 mm and from 6.15 to 7.93 mm, respectively, while the sphericity decreased from 0.789 to 0.835. In the moisture range from 10.06-27.06% d.b., studies on rewetted sunflower seeds showed that the thousand grain mass increased from 66 to 70 g, the true density from 885.00 to 902 kg m-3, the porosity from 53.06 to 54.93% and the terminal velocity from 4.07 to 4.57 m s-1. The bulk density decreased from 415.40 to 406.56 kg m-3 with an increase in the moisture content range of 10.06-27.06% d.b. The static coefficient of friction of sunflower seeds increased the linearly against surfaces of six structural materials, namely, rubber (0.55-0.65), aluminum (0.50-0.57), stainless steel (0.49-0.56), galvanized iron (0.53-0.59), glass (0.41-0.45) and MDF (medium density fiberboard) (0.43-0.48) as the moisture content increased from 10.06-27.06% db (Isik and Izli, 2007).

2.1.3 Pumpkin Seeds

The pumpkin seed has many health benefits and are considered nutritional powerhouses, with a wide variety of nutrients ranging from magnesium and manganese to copper, protein and zinc (Ardabili *et al.,* 2011).

Several physical properties of pumpkin seeds and kernels were evaluated as functions of moisture content. The average length, width, thickness and unit mass of the seed were 16·91 mm, 8·67 mm, 3·00 mm and 0·203 g respectively. Corresponding values for the kernel were 14·62 mm, 6·89 mm, 2·50 mm and 0·160 g respectively. In the moisture range from 4 to 40% d.b., studies on re-wetted seed showed that the bulk density increased from 404 to 472 kg/m3, true density decreased from 1179 to 1070 kg/m3, porosity decreased from 65·73 to 55·46% and terminal velocity increased from 4·7 to 6·5 m/s. For the kernel, the corresponding values changed from 481 to 554 kg/m3, 1080 to 1143 kg/m3, 55·46 to 51·53% and from 4·27 to 5·25 m/s respectively. In the moisture range of 4 to 27% d.b. the static coefficient of friction varied from 0·41 to 0·76 for seed and from 0·34 to 0·65 for kernel over different material surfaces, while angle of repose varied from 30 to 52° for seed and 34 to 42° for kernel (Joshi *et.al*, 2009).

2.1.4 Chia Seeds

Physical properties of Salvia hispanica L. seeds were investigated, and their application was also discussed. Physical properties were assessed for white and dark seed separately, except for the angle of repose and static coefficient of friction, which were determined for the seed mixture. The mean moisture content was 7.0% (dry basis). The average for the three characteristic dimensions, length, width and thickness was 2.11, 1.32 and 0.81 mm for dark seeds and 2.15, 1.40 and 0.83 mm for white seeds, respectively. The bulk density, true density and the porosity were between 0.667 and 0.722 g cm−3, 0.931 and 1.075 g cm−3, and 22.9 and 35.9%, respectively. The equivalent diameter ranged from 1.32 to 1.39 mm. The volume of single grain and sphericity ranged between 1.19 and 1.42 mm3, 62.2 and 66.0%, respectively. The geometric mean diameter ranged between 1.31 and 1.36 mm for dark and white chia seeds, respectively. This parameter could be used for the theoretical determination of seed volume and sphericity. One thousand seed mass averaged 1.323 g for dark seeds, and 1.301 g for white seed. The angle of repose varied between 16° and 18° whereas the value of static coefficient of friction was 0.28 on galvanized sheet and 0.31 on mild steel sheet (Ixtaina *et al.,* 2008).

2.2 Chemical Properties

Literature study for the chemical properties of Ashoka flower, Pumpkin seeds, Sunflower seeds and Chia seeds were carried out.

2.2.1 Ashoka Flower

The experimental yield of chloroform, ethanol, methanol and water extracts of Saraca flower were found to be 1.80% 11.90%, 15.10% and 22.00% respectively. The pH of the different parts of Ashoka is ranging from 5.25 to 6.40 being slightly acidic. Extractive values indicate the nature of constituents present in a raw drug. Such extractive values provide an indication of the extent of polar, medium polar and non-polar components present in the plant material. The extractive value of aqueous extract of Ashoka Flower is high (27%) whereas petroleum ether extract of tender leaf is very low (1.80%). Water soluble extractive value of S. asoca is found to be higher in comparison to alcohol soluble extractive value which denotes the possibilities of presence of higher amount of polar water soluble constituents in the flower of S. asoca. Water soluble extractive value showed the presence of sugar, acids and Inorganic compounds and alcohol soluble extractive values determined the presence of polar constituents. The physicochemical parameters total ash, acid insoluble ash and water soluble ash value were

found to be 3.00% 2.02% and 1.12% respectively. Total ash value percentage showed the amount of mineral and earthy material present in the plant sample. The amount of acid insoluble siliceous matter present In the plant sample was 2.02% (Borokar and Pansare, 2017).

Preliminary phytochemical results indicate the presence or absence of phytochemical constituents in different extracts of the Saraca flower. Carbohydrates, tannin, flavonoid, saponin, glycosides, proteins and steroids were found to be present in methanol and ethanol extracts. The chloroform extifact contained only carbohydrates whereas the water in addition to carbohydrates contain tannin, flavonoid, saponins, and steroids (Borokar and Pansare, 2017).

2.2.2 Sunflower Seeds

Hybrid sunflower seed (achene) were collected from plants at 7-day intervals after the initiation of flowering which occurred 58 days after planting. The seed were analyzed for moisture, total oil, free fatty acids, lipid classes, and fatty acid composition. Seed dry weight, oil and triglyceride contents were maximum 35 days after the initiation of flowering (DAF) when the seed moisture content was about 36%. This point was defined as “physiological maturity” for sunflowers (Cancalon, 1971).

The major components of the sunflower seed hull, lipids, proteins and carbohydrates were studied Lipids represent 5.17% of the total hull weights, 2.96% of which is wax composed of long chain fatty acids (C14–C28, mainly C20) and fatty alcohols (C12– C30, mainly C22, C24, C26). Hydrocarbon, sterol and triterpene alcohol fractions were also examined. The rest of the lipid fraction is an oil with a composition relatively similar to that of the kernel oil. The protein fraction (4% of the total hull weight) is similar to the protein fraction of the oil cake, although it contains hydroxyproline. The carbohydrate fraction is composed mainly of cellulose, but also of reducing sugars (25.7%), mainly pentoses .The fatty acid composition of the oil extracted from the seed was determined at each stage of maturity. Total saturated fatty acids were 27% at 7 DAF and then decreased to a constant 9% by 35 DAF. At 7 DAF, linolenic acid content was 10.7% then decreased to less than 0.1% by 28 DAF. Oleic acid was about 12% at 7 DAF, increased to 59.6% at 14 DAF, and then gradually decreased to 31.4% by 56 DAF. On the other hand, linoleic acid was about 48% at 7 DAF, decreased to 23% by 14 DAF, but then gradually increased to 59.2% by 56 DAF. An analysis of variance of linoleic and oleic acid contents from 21 DAF to 70 DAF showed a highly significant change in composition with maturation time. The changes in the composition of these fatty acids from 21 DAF to 70 DAF appeared to be related to the environmental temperature which gradually decreased until 56

DAF. Increase in free fatty acids after physiological maturity indicated that deterioration of seed oil was beginning to occur (Cancalon, 1971).

2.2.3 Pumpkin Seeds

The moisture content of whole pumpkin seed (5.53±0.26%) was higher than the kernels (4.43±0.44%). The results of moisture content were found similar with the earlier findings reported by Elinge *et al*., (2012) , Steiner-Asiedu *et al*., (2014) and Al-Anoos *et al*., (2015) . The kernel has high protein content, crude fat content and total carbohydrate than whole pumpkin seed. The results of protein, crude fat, ash and carbohydrate observed during the present study are in good accordance with the results reported by Ardabili *et al*., (2011), Eling *et al*., (2012) and Steiner-Asiedu *et al*., (2014).

Crude fibre was in accordance with the findings reported by Al-Anoos *et al*., (2015) and Alfawaz (2004) but moderately less compared to the result reported by Karanja *et al*., (2013). The phytic acid content of whole pumpkin seed were found to be higher than the kernels. However, some differences in the composition may be due to environmental stress, climatic conditions, geographical, cultivation and harvesting practices. It mainly consists of linoleic acid, oleic acid, palmitic acid, stearic acid, palmitolic acid, arachidic acid, erusic acid, behenic acid and linolenic acid. Major free fatty acid compounds of pumpkin seeds are linolenic acid, oleic acid, palmitic acid and stearic acid , linolenic acid, oleic acid, palmitic acid and stearic acid as the major free fatty acid compounds in pumpkin seed oil (RodriguezMiranda *et al*., 2013)

Similarly the major free fatty acids compounds of pumpkin seeds as linoleic acid, oleic acid, palmitic acid and stearic acid with slightly higher values of linoleic acid (39.84±0.08%) and oleic acid (38.84±0.37%) and lower values of palmitic acid (10.68±0.42%) and stearic acid (8.67±0.27%). The results obtained were found to be in similar with the findings of Elinge *et al*., (2012) . The differences in free fatty acids composition might be attributed due to the factors such as variety, origin, and drying conditions, among others (Gohari Ardabili *et al*., 2011).

2.2.4 Chia Seeds

The chemical composition of chia seeds has been analysed in many studies. Chia seeds contain approximately 30–34g dietary fibre, of which the insoluble fraction (IDF) accounts for approximately 85–93%, while soluble dietary fibre (SDF) is approximately 7–15%. The fatty acid profile is of particular interest. It is characterized by high contents of polyunsaturated fatty

acids, mainly α-linolenic acid (ALA), which accounts for approximately 60% all fatty acids. Linoleic, oleic and palmitic acids are found in lower amounts. Chia seeds have greater contents of omega-3 acids than flaxseed. The ratio of omega-6 to omega-3 acids, is approximately 0.3:0.35 (Jain *et al.,* 2023).

Chia seeds are also a good source of plant protein, which accounts for approximately 18–24% their mass. Analyses of the amino acid composition confirmed the presence of 10 exogenous amino acids, among which the greatest contents were for arginine, leucine, phenylalanine, valine and lysine. Proteins in chia seeds are also rich in endogenous amino acids, mainly glutamic and aspartic acids, alanine, serine and glycine. It needs to be stressed that chia seeds are gluten-free and as such may be consumed by celiac patients. Moreover, chia seeds supply many minerals, with phosphorus (860–919 mg/100 g), calcium (456–631 mg/100 g), potassium (407–726 mg/100g) and magnesium (335–449 mg/100 g) found in greatest amounts. Studies also confirmed the presence of some vitamins, mainly vitamin B1 (0.6 mg/100 g), vitamin B2 (0.2 mg/100 g) and niacin (8.8 mg/100 g). Chia seeds are also a rich source of particularly interesting groups of phytocompounds characterised by high biological activity. These are particularly polyphenols: gallic, caffeic, chlorogenic, cinnamic and ferulic acids, quercetin, kaempferol, epicatechin, rutin, apigenin and p-coumaric acid. Isoflavones, such as daidzein, glycitein, genistein and genistin, are found in small amounts. Ciftci *et al*. showed the presence of campesterol (472 mg/kg of lipids), stigmasterol (1248 mg/kg of lipids), β-sitosterol (2057 mg/kg of lipids) and Δ5-avenasterol [26]. Moreover, it was found that chia seeds also contain tocopherols: α-tocopherol (8 mg/kg of lipids), γ-tocopherol (422 mg/kg of lipids and δ-tocopherol (15 mg/kg of lipids) (Jain *et al.,* 2023).

2.3 Nutritional Composition

Literature study for the nutritional composition of Ashoka flower, Pumpkin seeds, Sunflower seeds and Chia seeds were carried out.

2.3.1 Ashoka Flower

Saraca indica commonly referred to as Ashoka tree in the Indian subcontinent, is screened for potential antimicrobial and antioxidant properties of the phytochemicals present in the leaves. The leaves are rich in saponins as shown by the preliminary testing of phytochemicals. Phytochemical profile of the saponin-rich extract of the leaves was obtained by using the GCMS (Gas Chromatography-Mass Spectra) data which revealed a total of 30

bioactive compounds. The total saponin content was represented by 11 of these phytochemicals and they accounted for 73% of the total of the 30 bioactive compounds. The extract of these phytochemicals with the predominant presence of saponins exhibited *in-vitro* antimicrobial and antioxidant properties. Saponins are known to have properties to treat skin-related ailments and the leaves of *Saraca indica* can serve as an abundant herbal source of saponins. *Saraca indica L. (Saraca asoca)* is reported for its important biological benefits in Indian folk medicine. Phytochemicals such as saponins, flavonoids, tannins, terpenoids and steroids have antiinflammatory effects. Glycosides, flavonoids, tannins and alkaloids have hypoglycemic activities. Saponins possess hypocholesterolemia and anti-diabetic properties. The terpenoids have also been shown to decrease blood sugar level. Overall, the nutritional properties of *Saraca indica* are primarily attributed to its rich composition of saponins, phenolics, and flavonoids, which contribute to its antioxidant, antimicrobial, and hematoprotective effects (Kokane *et al.,* 2023).

2.3.2 Sunflower Seeds

Sunflower seeds are nutrient-dense, packing a wide range of vitamins, minerals, and antioxidants into a small serving. Just 1 ounce (28.35 grams or 1/4 cup) of shelled, dry roasted sunflower seeds provides 165 calories, 14.1 grams of fat, 5.5 grams of protein, 6.8 grams of carbs, and 3.2 grams of fibre. They are especially rich in vitamin E (49% of the Daily Value) and selenium (41% DV), both of which act as powerful antioxidants that help protect the body's cells from free radical damage linked to chronic diseases. Sunflower seeds also offer notable amounts of copper (58% DV), manganese (26% DV), pantothenic acid (40% DV), folate (17% DV), zinc (14% DV), vitamin B6 (13% DV), and niacin (13% DV). In addition to these nutrients, sunflower seeds are a good source of plant compounds like phenolic acids and flavonoids, which further enhance their antioxidant benefits. Proteins from sunflower seeds do not contain all the essential amino acids. However, when combined with grains, they enhance the biological value of plant proteins. Xylan's, xyloglucans, and pectin's are the main non starch polysaccharides found in this seed. Sunflower seeds are also an excellent source of vitamins and minerals such as thiamine, folic acid, vitamin B6, vitamin E, iron, phosphorus, magnesium, zinc, copper, and selenium. A high percentage of fat is also present in sunflower seeds. More than 90 percent of its fat is polyunsaturated fatty acids, especially linoleic acid or omega 6. Sunflower seeds are an excellent source of vitamin E, the body's main lipid-soluble antioxidant.

Approximately 90 percent of the daily vitamin E requirement can be met by consuming a quarter cup of sunflower seeds. Fat is the major source of calories in sunflower seeds.

Approximately 163 calories and 14 grams of fat are contained in one ounce of de-shelled seeds. As a good source of mono-unsaturated and poly-unsaturated fatty acids, sunflower seeds help remove plaque that can form low-density lipoproteins in blood vessels (Fernando, 2024).

Phytochemicals such as choline, lignan, phenolic acids and betaine, as well as amino acids such as arginine, are abundant in sunflower seeds. Sunflower seeds contain magnesium, which is beneficial for maintaining bone health. Copper in sunflower seeds plays avital role in the cross-linking of collagen and elastin, providing strength and flexibility to bones and joints. Sunflower seeds are also a good source of selenium, an essential mineral trace for human health. Folate is also found in sunflower seeds. An ounce of sunflower seed contains about 17 percent of the recommended daily amount. Sunflower seeds are a good source of plant protein, providing 6 grams or 12 percent of the daily value per ounce. The iron content of one ounce of sunflower seed accounts for 10% of the Daily Value. The manganese content of sunflower seeds is 37% of the daily value per cup. A significant source of zinc, sunflower seeds improve immune health and fight against infections. Sunflower seeds and oil contain unsaturated fats that may protect the heart, including monounsaturated oleic acid and polyunsaturated linoleic acid. Sunflower seeds contain vitamin B-6, which can alleviate depression. As a source of fiber, sunflower seeds promote good health by lowering blood cholesterol, controlling blood sugar levels, and preventing constipation (Petraru *et al*., 2021).

2.3.3 Pumpkin Seeds

Pumpkin seeds are considered as an important functional food component that contributes to human nutrition significantly. Pumpkin seeds contain approximately, 6.37%–6.56% moisture content, 35%–50% lipids, 25%–37% proteins, 18%–25% carbohydrate, 3%–6% fiber and 3%– 5% ash. This difference in moisture content is attributed to the varietal difference along with climatic conditions. Pumpkin seeds are rich in fat and protein content which can help in curbing many nutritional disorders (malnutrition) or preventing from various ailments (Batool *et al*., 2022).

Pumpkin seeds contain good quality lipids (fat) which are composed of many essential and non-essential fatty acids including ω-3, ω-6 and ω-9 fatty acids. Fat content in different species of pumpkin seeds ranged from 10.70%–56.24% as reported which makes it favorable

ingredient for edible oil extraction. Oil extracted from pumpkin seeds can be used as edible oil and as other fat replacers in food industry. Proteins are also found in abundant amount in pumpkin seeds and its flour is being substituted in various amounts in formulations of biscuits, cookies and crackers. Pumpkin seeds are also used for formation of protein isolate. Nutritional composition of pumpkin seeds was studied by various researchers, and they reported abundant number of proteins, fat and fiber which make pumpkin seeds nutritionally superior and changed its status from agricultural waste to nutritional powerhouse. Pumpkin seed possesses handsome amount of protein content, and its value varied from 24.20%–40.00% for different species (Kumari, *et al.,* 2025).

Pumpkin seeds contain approximately 0.95%–16.84% fiber as reported by various researchers in different varieties. Pumpkin seeds contain variable amounts of carbohydrates which make it a valuable constituent in food formulations. Carbohydrate content varied from 1.00%–26.43% in pumpkin seeds of several varieties and these seeds can be used in formulation of various bakery products like cake, cookies, bread, etc. Ash content of the seed was reported in the range of 1.60%–7.20% in different varieties of pumpkin seeds (Ali *et al*., 2023).

2.3.4 Chia Seeds

Chia seeds are highly nutritious, offering 42g of carbohydrates, 17g of protein, and 31g of fat per 100g, along with 13g of dietary fiber. They are rich in minerals, especially calcium (631 mg), phosphorus (860 mg), magnesium (335 mg), and potassium (407 mg). Chia seeds also contain notable amounts of B vitamins, particularly niacin (8.83 mg) and thiamine (0.62 mg). Their fat profile is dominated by omega-3 fatty acids (63.79%), making them excellent for heart and brain health. Additionally, chia seeds provide antioxidants like caffeic acid and quercetin, contributing to their anti-inflammatory and protective properties. The protein content of chia seeds is around 17%, greater than the protein content in all other cereals (for instance, in corn the protein content is 9.4%, rice is 6.5%, quinoa 14.1%, and in wheat 12.6%).

Chia seeds are believed to be a starting material in the food industry for their dietary fiber. Gum can be extracted from dietary fiber fraction by using water as an additive to control viscosity, stability, and texture. The chemical composition, molecular structure, and the derived properties such as thermal stability or gelling ability represent important factors which determine the appropriateness of a polysaccharide in food and pharmaceutical industries (Das *et al.,* 2018).

The U.S. Department of Agriculture has confirmed that chia seeds contain some exogenous amino acids (arginine, leucine, phenylalanine, valine, and lysine) and some endogenous amino acids (glutamic and aspartic acid, alanine, serine, and glycine). A total of 20 proteins were obtained from chia seeds, eight of them were specially related to the production of plant lipids, which cause the high concentrations of polyunsaturated fatty acids presented. The fiber content in chia seeds is also very high. Chia seeds contain between 34 g and 40 g of dietary fiber per 100 g. Additionally, chia seeds contain minerals like calcium, phosphorus, potassium, magnesium, and vitamins (A, B, K, E, D, mainly vitamins B1, B2, niacin). The content of calcium, for instance, is greater than in rice, barley, corn, and oats. The content of other minerals such as magnesium, potassium, and phosphorus are greater in chia seeds as well than in other cereals. Focusing on phenolic content, dry chia seeds contain 8.8% of phenolic compounds. Besides, in the same study, vitamins A, B1, B2, and B3 were identified in chia seeds for the first time. The flavonoids quercetin, chlorogenic acid, and caffeic acid are proven to have anti-cancerogenic, anti-hypertensive, and neuron protective effects. Some researchers reported that the chemical composition and nutritional values may vary due to climatic conditions, geographic location, nutrients, and year of cultivation. For example, the composition of fatty acids may vary according to climate change and the altitude of the plant, the colder and higher the region, the higher the content of ω-3 unsaturated fatty acid (Ivanovski *et al*., 2019).

2.4 Therapeutic Properties

Literature study for the therapeutic properties of Ashoka flower, Pumpkin seeds, Sunflower seeds and Chia seeds were carried out.

2.4.1 Ashoka Flower

Saraca indica commonly known as Ashoka, is a medicinal tree native to the Indian subcontinent. For centuries, it has held a significant place in traditional Ayurvedic and folk medicine systems due to its therapeutic properties. This plant has been traditionally utilized to address various health issues, particularly those related to women's well- being. Its bark, leaves, and flowers contain bioactive compounds such as alkaloids, flavonoids, tannins, and saponins, which confer therapeutic properties. The tree is known for its astringent, anti-inflammatory, and uterine tonic properties, making it a valuable resource for treating conditions like menstrual disorders, menorrhagia, dysmenorrhea, and leucorrhoea. Moreover, Ashoka's antiinflammatory

characteristics are beneficial in managing conditions like arthritis and rheumatism (Kokane *et al.,* 2023).

The tree's potential as an antimicrobial agent has also been explored, with extracts exhibiting antibacterial and antifungal properties. This has implications for treating various infections and promoting wound healing. Additionally, *Saraca indica* has demonstrated antioxidant activity, which can help combat oxidative stress and its associated health issues. Furthermore, Ashoka has shown promise in supporting reproductive health. Its uterine tonic properties make it useful in managing female reproductive disorders, and it is believed to have a role in promoting overall fertility. While *Saraca indica* has been a part of traditional medicine for centuries, further research is necessary to better understand its mechanisms of action and to evaluate its efficacy in a modern clinical context. However, the diverse array of potential medicinal uses for *Saraca indica* underscores its significance in the world of natural remedies and traditional healing practices (Kokane *et al.,* 2023).

The Ashoka tree is both a sacred and traditional plant, as well as a popular therapeutic cure. Itching, ulcers, eczema, psoriasis, dermatitis, scabies, and inflammation are commonly treated with the leaves and blooms of the Ashoka tree. Colds, vaginal issues, diabetes, and a number of other ailments are all treated with it. There are Alkaloids, Flavonoids, Glycosides, Saponins, Phenols, Steroids, Tannins, and Triterpenoids involved (Athiralakshmy *et al*., 2016).

2.4.2 Sunflower Seeds

Sunflower seeds are an excellent source of antioxidants like vitamin E, healthy fats, B vitamins, and copper and other minerals. They contain nutrients that fight cancer, lower your risk of heart disease, balance blood sugar, support thyroid health and lower inflammation. They also provide nutrients that have anti-cancer properties. "Inflammation and high cholesterol both contribute to hardening of your arteries, or atherosclerosis," explains Culbertson. "So, sunflower seeds are truly a heart-healthy food." It supports thyroid health – "Thyroid disorders are very common," says Culbertson. "And they can really wreak havoc on your life and wellbeing." Your thyroid plays a role in several functions in your body, including bone maintenance, cell growth, digestion, heart function, metabolism. It fights inflammation. Inflammation is a word that gets tossed around a lot, and for good reason. The link between chronic inflammation and serious diseases is well known. It is a risk factor for conditions such as allergies, arthritis, cancer, cardiovascular diseases, diabetes, and stroke. They prevent muscle

cramps. Sunflower seeds are rich in several essential minerals. Two of them, magnesium, and pantothenic acid, are great for keeping muscle cramps away (Clinic, 2025).

2.4.3 Pumpkin Seeds

Pumpkin seeds extracts exhibited greater zone of inhibition against these fungal strains as compared to pumpkin peel and flesh extracts. For antibacterial study four bacterial strains Salmonella typhi, Escherichia coli, Bacillus subtilis and Streptococcus aureus were used. Pumpkin flesh extracts exhibited greater antibacterial activities as compared to pumpkin peel and seeds extracts. The antidiabetic and antihyperlipidemic activity of different extracts of Cucurbita maxima seeds was evaluated in wistar albino rats against streptozotocin (50 mg/kg ip) at dose of 200 mg/kg po for 21 days. Glibenclamide (500µg/kg) was used as reference drug. Fasting blood glucose (FBG) levels were measured on day 0, 7, 14 and 21. It was found that blood glucose concentration was significantly ($P< 0.05$) decreased compared to control. In addition, oral administration of Cucurbita maxima significantly ($P< 0.05$) decreased serum total cholesterol, LDL, VLDL, triglycerides and at the same time markedly increased serum insulin and HDL-cholesterol levels. Administration of glibenclamide, a reference drug also produced a significant ($P< 0.05$) reduction in blood glucose concentration in streptozotocin induced diabetic rats. Thus, the results of this experimental study shows that Cucurbita maxima possess antidiabetic and antihyperlipidemic effect and is able to ameliorate the diabetic state and is a source of potent antidiabetic agent (Sharma *et al*., 2013).

2.4.4 Chia Seeds

The ancient grain is becoming enormously popular in modern food regimen in many countries; the higher proportion of α-linolenic acid makes chia the superb source of omega-3 fatty (about 65 % of the oil content). Omega-3 fatty acid has been associated with a large number of physiological functions in human body (Hajhashem *et al*., 2010).

Chia seed is a potential source of antioxidants with the presence of chlorogenic acid, caffeic acid, myricetin, quercetin, and kaempferol which are believed to have cardiac, hepatic protective effects, anti-ageing and anti-carcinogenic characteristics. It is also a great source of dietary fibre which is beneficial for the digestive system and controlling diabetes mellitus with higher concentration of beneficial unsaturated fatty acids, gluten free protein, vitamin, minerals and phenolic compounds. Therapeutic effects of chia in the control of diabetes, dyslipidaemia, hypertension, as anti-inflammatory, antioxidant, anti-blood clotting, laxative, antidepressant,

antianxiety, analgesic, vision and immune improver is scientifically established (Hajhashem *et al.,* 2010).

Chia seeds contain more than one functional component. The importance of these components has the ability to suppress the risk of chronic diseases including GI- tract- related diseases, CVD, and various types of cancer. Fiber, omega- 3 fatty acid, protein, polyphenols, phytosterols, vita mins, and minerals reduce heart diseases by controlling bad choles terol, hypertension, and platelet aggregation. In the GI tract, chia seed components reduce type 2 diabetes by improving the beta- cell performance and reducing the blood glucose level. Moreover, chia seeds have rich fiber that provides bulk to stool, so these seeds can prevent constipation. However, antioxidants and phenolic part of these seeds improve oxidation and aid in reducing the risk of different types of cancer. In the future, Chia seed components may be used as an additive ingredient in different food products such as meat products and baking products to improve the nutrition value and shelf stability (Chávez *et al*., 2008).

3. METHODOLOGY

The present study entitled **"Formulation and Culinary Application of WomenFocused Health Supplement Mix"** were conducted with the following headings.

3.1. Development of women health mix

3.1.1. Selection of ingredients

3.1.2. Procurement and pre-processing of selected ingredients

3.1.3. Incorporation of health mix into selected recipes.

3.1.4. Organoleptic evaluation of health mix incorporated recipes

3.1.4.1. Formulation of different combinations and selection of the best one

3.1.4.2. Selection of judging panel

3.1.4.3. Standardization and sensory evaluation of developed products

3.2. Calculation of nutritive value of the best variation.

3.1. Development of women health mix

The health mix for women was formulated with the following steps.

3.1.1. Selection of Ingredients

The ingredients selected for the formulation of health mix were Ashoka flower (*Saraca asoca*), Chia Seeds (*Salvia hispanica*), Pumpkin seeds (*Cucurbita pepo*) and Sunflower seeds (*Helianthus annus*).

Ashoka (*Saraca asoca*) flower - The flower which is well known for its medicinal and functional properties (Plate 1). It is considered a very effective remedy for the treatment under all kinds of women's reproductive system conditions. For the study, it has been selected fresh, pesticide free flower from local areas of Kollam district.

Chia Seeds (*Salvia hispanica*) - Clean and air tight packed, moisture free seeds were purchased from the supermarket at Ernakulam district (Plate 5).

Pumpkin seeds (*Cucurbita pepo*) – Matured, dried and airtight packed pumpkin seeds were purchased from supermarket at Ernakulam district. Special care had been given as the seeds did not have any kind of rancidity and off taste or smell (Plate 4).

Sunflower seeds (*Helianthus annus*) - Matured, dried, unshelled and airtight packed sunflower seeds were purchased from supermarket at Ernakulam district. Special care had been given as the seeds were not having any kind of rancidity, off taste or smell (Plate 3).

3.1.2. Procurement and pre-processing of selected ingredients

Fresh Ashoka flowers were collected from different parts of Kollam district. After washing the flowers, sundried (Plate 2) it for 2 days and ground them into a fine powder.

Chia seeds, sunflower seeds and pumpkin seeds were roasted separately, allowed to cool and then each ingredient was grounded well into fine powder.

After the preparation of all powders, the health mix was prepared by combining 50 grams Ashoka flower powder, 20 grams of pumpkin seed powder, 20 grams of sunflower seed powder and 10 grams chia seed powder to obtain a quantity of 100 grams of powder (Plate 6).

Plate. 1
Ashoka flower

Plate. 2
Dried Ashoka Flower

Plate. 3
Sunflower Seeds

Plate. 4
Pumpkin Seeds

Plate. 5
Chia Seeds

Plate. 6
Health Mix

3.1.3. Incorporation of health mix into selected recipes.

Seven recipes suitable for Ashoka flower, chia seed, pumpkin seed, and sunflower seed incorporation were collected initially. The recipes selected for incorporation were rava ladoo, muffins, cookies, kesari, smoothie mix, ela ada, avalose ball.

3.1.4. Organoleptic evaluation of health mix incorporated recipes

Organoleptic evaluation is a sensory assessment that uses the five senses (sight, smell, taste, touch, and hearing) to analyze and evaluate a material or product. It's essentially a subjective assessment based on how the material or product feels and looks to the evaluator. Sensory experience is a key factor in product quality and consumer perception. It serves as a primary screen to determine which samples must be analyzed according to the original method protocol, and which samples need no further sensory analysis. Sensory evaluation is an invaluable tool for Quality Control as well as Research and Development. Customers perceive product quality with their senses, and as a result, organoleptic evaluations are an essential component of any Quality Control evaluations (Lawless and Heymann, 1998).

The developed products were evaluated organoleptically to access their sensory qualities.

3.1.4.1. Formulation of different combinations and selection of the best one

Three different variations of each product were prepared using the following ratios to test different combinations of the main ingredient and the Ashoka flower powder:

T1 – 80:20 – 80% of main ingredient + 20% of health mix powder

T2 – 70:30 – 70% of main ingredient + 30% of health mix powder

T3 – 60:40 – 60% of main ingredient + 40% of health mix powder

The incorporated products were evaluated organoleptically by the selected judging panel.

Plate. 7 Health mix incorporated- Smoothie

Plate. 8 Health mix incorporated- Kesari

Plate. 9 Health mix incorporated - Ela ada

Plate. 10 Health mix incorporated- Cookies

Plate. 11 Health mix incorporated- Avalose ball

Plate. 12 Health mix incorporated- Muffins

Plate. 13 Health mix incorporated- Rava ladoo

3.1.4.2. Selection of judging panel

To assess the acceptability of the products through sensory evaluation, a panel of 10 judges were selected. The panel members were selected on the basis of their ability to perceive and recognize the variations in the quality of different food items. For each product, four variations were prepared and given, from which, the judging panel would select the acceptable product on basis of its taste, texture, colour, flavour and appearance. Each of them was provided with 9-point hedonic scale sensory evaluation sheet, on which they could mark their respective scores.

3.1.4.3. Standardization and sensory evaluation of the developed products

Sensory evaluation of food has become huge area of interest for researchers and food manufacturers (Lawless and Heyman, 2010). Standardization and accreditation of sensory quality evaluation methods are a pressing need for the certification of food products, particularly for food and beverages with specific sensory characteristics (Elortondo *et al*., 2007). There is a need to develop healthy and therapeutic products using low cost (Rema and Kamaliya, 2008).

In this study, it had been incorporated the blend of Ashoka flower, Sunflower seeds, Pumpkin seeds and Chia seeds in the ratio of 50:20:20:10 to develop a 100 g of women – focused health supplement mix. These ingredients were incorporated into selected products to form three variations, namely T1 ,T2, T3. In the sensory evaluation, the sensory attributes of a food such as taste, colour, flavour, texture and appearance were evaluated by the judging panel

and asked to select best variation. Each member of the judging panel tasted and evaluated the products and marked their score in the score card.

Plate. 14 Sensory evaluation of Health mix incorporated product

3.2. Nutritive value of formulated recipes

The nutrient content of the developed products per 100g were calculated using Nutrient Composition Table (NIN,2017) with reference to their Energy, Carbohydrates, Protein, Fat, Fiber, Calcium, Iron, Zinc, Magnesium, Vitamin C, Vitamin D.

4. RESULT AND DISCUSSION

Salient features of the study entitled **"Formulation and Culinary application of Women-Focused Health Supplement Mix"** were discussed under the following headings:

4.1. Organoleptic evaluation of health mix incorporated products

4.1.1. Smoothie

4.1.2. Kesari

4.1.3. Ela Ada

4.1.4 Cookies

4.1.5. Muffin

4.1.6. Avalose Ball

4.1.7. Rava Ladoo

4.2. Nutrient composition of health mix incorporated products

4.1 Organoleptic evaluation of health mix incorporated products

Quality is the ultimate criterion of the desirability of any food product. When the quality of food product is assessed by means of sensory organs, the evaluation is said to be sensory or subjective or organoleptic (Srilakshmi, 2009). Food industry is promoting more nonperishable food items because of its long shelf life and quality. Hence the developed Asoka flower mix incorporated products were analysed organoleptically to assess their sensory quality and acceptability. The judges were asked to determine the best of the three variations of each product using a 9 point hedonic scale point score card (Appendix. I).

Tables below show the scores obtained by each variation for overall acceptability. The mean score of the all the quality attributes of a variation was taken as the overall the acceptability score of that variation. The variation with the highest overall acceptability score taken was as the best variation of the product prepared incorporating Asoka flower mix.

4.1.1. Smoothie

The result for the health mix incorporated – Smoothie were present in the table 1.

Table 1. Sensory evaluation of health mix incorporated – Smoothie

Quality Attributes	Variations			
	T0 (Control)	T1 (20%)	T2 (30%)	T3 (40%)
Appearance	8	8.3	8.3	8
Colour	7.9	8.2	8.3	8.1
Flavour	8	8.2	8.4	8.2
Texture	8.2	8.3	8.2	8.2
Taste	8.2	8.1	8.3	8.2
Overall acceptability	8	8.2	8.2	7.9
Average Score	8.05	8.21	8.28	8.1

Appearance

The visual attributes of a food product, including its shape, color, and surface texture, are essential in determining its overall appeal. Consumers often rely on these characteristics, particularly color and presentation, to evaluate the quality of food items (Brown and Davis, 2022).

Considering the appearance of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T1 (20% incorporation) and T2 (30% incorporation) obtained similar scores (8.3) as compared with the T3, which had the lowest score.

Colour

Colour is one of the most important sensory attributes of food, as it is often the first quality cue used by consumers to make judgments about freshness, ripeness, and overall appeal; it can significantly influence the perception and acceptability of a product (Francis, 1995).

Considering the colour of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T2 had the highest score (8.3).

Taste

The taste of a food product is a sensation that is perceived through the taste buds that are present on the tongue. It is a very important characteristic of food. Considering the taste of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% health mix respectively, T2 had the highest score (8.3).

Texture

The perception of food texture is an integrated sensory experience involving visual, tactile, and auditory cues, where visual expectations shaped by previous experiences, tactile sensations such as mouthfeel and hand feel, and sound characteristics like crunch and crispness all contribute to the overall sensory evaluation (Szczesniak, 2002).

Considering the texture of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively. T1 had the highest score (8.3).

Flavour

Flavour is a complex sensory experience resulting from the integration of taste and olfactory stimuli, combined with other sensations such as texture, temperature, and irritation, contributing to the overall perception of food and drink (Delwiche, 2004).

Considering the flavour of the three variations, TI, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively. T2 had the highest score (8.4).

Overall acceptability

Considering the overall acceptability of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T1 (20% incorporation) and T2 (30% incorporation) obtained similar scores (8.2) as compared with the T3, which had the lowest score.

Summary

The overall summary of the scores obtained by health mix incorporated smoothie was presented in Figure 1.

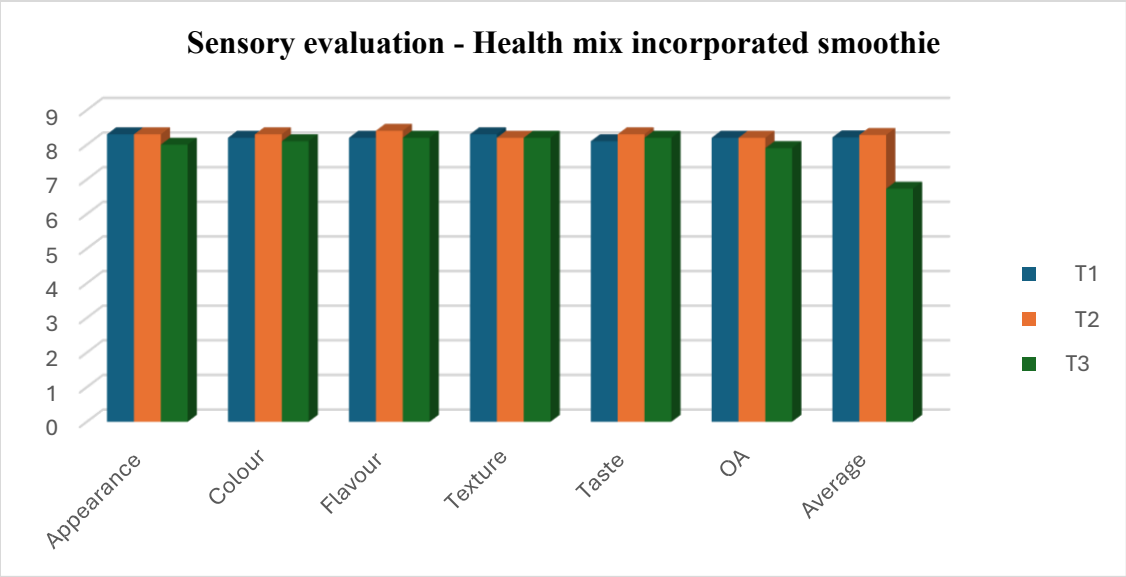

Figure 1. Sensory evaluation of health mix incorporated - smoothie

Based on sensory criteria, T2 (30% incorporation) was shown to be the most desired version, with T1 (20%) coming in second. These amounts of the health mix seem to improve the smoothie's sensory appeal without having an adverse effect on consumer approval. It could be necessary to modify the formulation at higher incorporation levels (T3) in order to preserve desired sensory qualities and enhance palatability. Among all the variations, **T2 (30% incorporation)** consistently scored the highest average (8.28), suggesting it was the most preferred formulation overall. This can be attributed to the optimal balance between the added health mix and the base smoothie, enhancing the flavour and taste without compromising texture or appearance.

4.1.2. Kesari

The results for the sensory evaluation of health mix incorporated Kesari were present in the table 2.

Table 2. Sensory evaluation of health mix incorporated Kesari

Quality Attributes	Variations			
	T0 (Control)	T1 (20%)	T2 (30%)	T3 (40%)
Appearance	7.5	7.5	7.7	7.8
Colour	7.7	7.8	7.7	7.8
Flavour	7.6	7.7	7.8	7.8
Texture	7.4	7.5	7.8	7.7
Taste	7.5	7.6	8	7.9
Overall acceptability	7.7	7.6	7.8	7.7
Average Score	7.5	7.6	**7.8**	7.7

Appearance

The visual qualities of a food item, such as its color, form, size, texture, and overall look, play a significant role in its appearance. These aspects, especially the color and appearance, are commonly used by consumers to judge the quality of different food products (Smith and Johnson, 2021).

Considering the appearance of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% health mix respectively, T1 (20% incorporation) and T2(30% incorporation) obtained significantly lowest scores T1 and T2 (7.5 and 7.7). Thus, they were not accepted by the judges.

Colour

The color of a food product is an essential visual attribute that results from the interaction of light with its surface, influencing how it is perceived by consumers (Gomes *et al.*, 2021). It is a key factor in determining a product's appeal, as it is often one of the first aspects noticed, influencing the initial judgment of its quality (Li *et al.,* 2022; Chen *et al.,* 2023). Depending on the color, it can either attract or repel potential consumers, affecting their decision to purchase (Chen *et al.*, 2023).

Considering the colour of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T3 had the highest score (7.8).

Flavour

The flavor of a food product is the sensory experience resulting from taste and smell, including aroma, taste, and other detectable physical traits (Saqqa, 2022). According to Williams *et al.* (2023), flavor encompasses all the sensory impressions encountered when consuming food, including its aroma and taste.

Considering the flavour of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T2 and T3 had the highest score (7.8).

Texture

Texture assessment involves interpreting sensory experiences through visual, tactile, and auditory cues, with each influencing how food is perceived (Rustagi, 2020). According to Patel *et al.* (2021), food texture is evaluated based on sensory signals such as sight, touch, and sound, with each contributing to the overall texture experience.

Considering the texture of the three variations. T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Asoka mix powder respectively, T2 had the highest score (7.8).

Taste

The taste of a food product is a sensation that is perceived through the taste buds that are present on the tongue. It is a very important characteristic of food. Considering the taste of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Asoka mix powder respectively, T2 had the highest score (8.0).

Overall acceptability

Considering the overall acceptability of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix powder respectively, T2 had the highest score (7.8).

Summary

The overall summary of the scores obtained by health mix incorporated Kesari was presented in Figure 2.

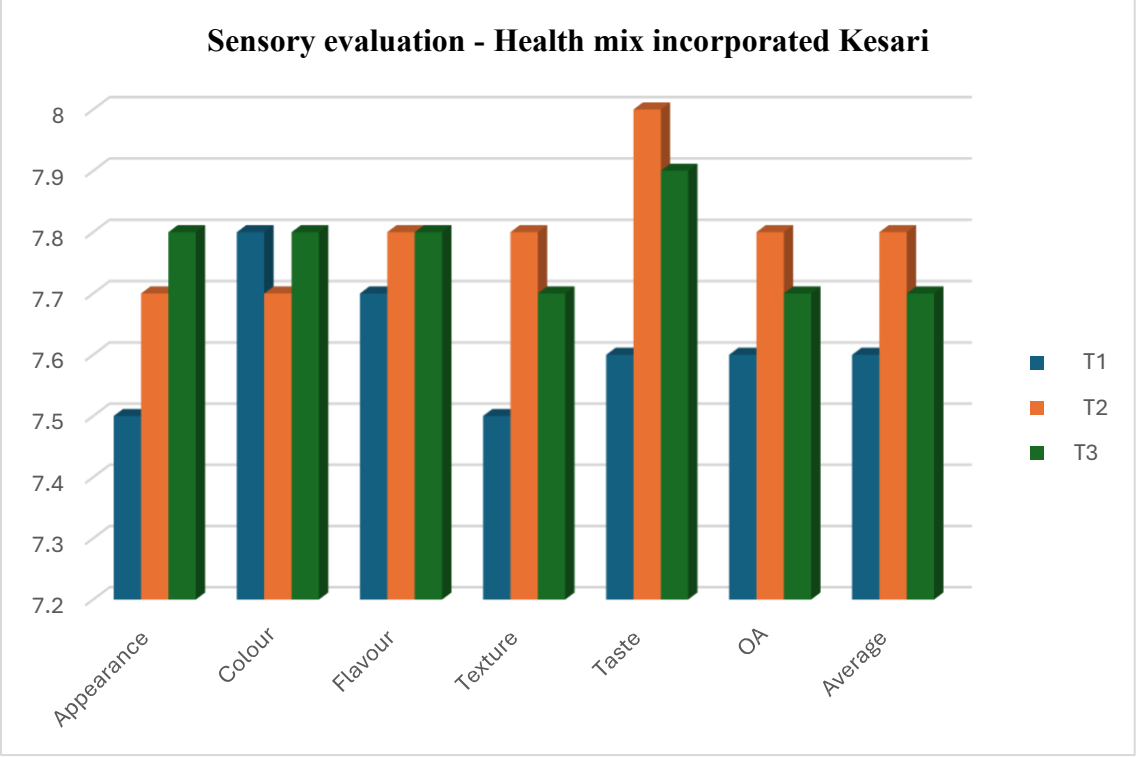

Figure 2. Sensory evaluation of health mix incorporated Kesari

In conclusion, T2 (30% health mix inclusion) showed the greatest sensory profile of all the variations, suggesting that it improved Kesari's nutritional value without having an adverse effect on customer appeal. T2 was comparatively better in most areas, indicating that 30% inclusion was ideal for preserving both taste and sensory appeal, even though T3 (40%) was equally well liked. The T2 variety (30% health mix integration) was the most desired formulation overall, according to the data, which showed that it had the highest average score of 7.8.

4.1.3 Ela Ada

The result for sensory evaluation of the Health mix incorporated Ela Ada was present in the table 3.

Table 3. Sensory evaluation of Health mix incorporated Ela Ada

Quality Attributes	**Variations**			
	T0 (Control)	**T1 (20%)**	**T2 (30%)**	**T3 (40%)**
Appearance	8	8.1	8.1	7.8
Colour	8	8 1	8	8.2
Flavour	7.2	7.4	7.1	7.3
Texture	7.9	8.1	8.2	7.9
Taste	8.1	8.3	8.1	7.1
Overall acceptability	8	8.2	8.2	7.2
Average Score	7.8	**8.5**	7.9	7.5

Appearance

The appearance is the first impression that most consumers have of a food, which they use to judge its desirability and acceptability (Hutchings, 2011).

Considering the appearance of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix, T2 (30% incorporation) and T3 (40% incorporation) obtained significantly lowest scores (7.9 and 7.5) as compared with the T1 (8.5). Thus, they were not accepted by the judges.

Colour

Colour is also an indicator of freshness and quality, which can significantly affect consumer's perception and purchasing decisions (Martins *et al*., 2021).

Considering the colour of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T3 had the highest score (8.2).

Taste

The taste of a food product is a sensation that is perceived through the taste buds that are present on the tongue. It is a very important characteristic of food. Considering the taste of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T1 had the highest score (8.3).

Texture

Texture perception is a complex multisensory experience involving mechanical, geometrical, and moisture-related attributes, all of which contribute to a consumer's overall acceptance and enjoyment of food (Szczesniak, 2021).

Considering the texture of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T2 had the highest score (8.2).

Flavour

Flavour perception is shaped not only by taste and aroma but also by temperature, texture, and even visual cues, making it a highly integrated and subjective sensory experience (Delarue *et al.,* 2021).

Considering the flavour of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Ashoka Flower powder respectively, T1 had the highest score (7.4)

Overall acceptability

Considering the overall acceptability of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T1 and T2 had the highest score (8.2 and 8.2).

Summary

The overall summary of the scores obtained by health mix incorporated Ela ada was presented in Figure 3.

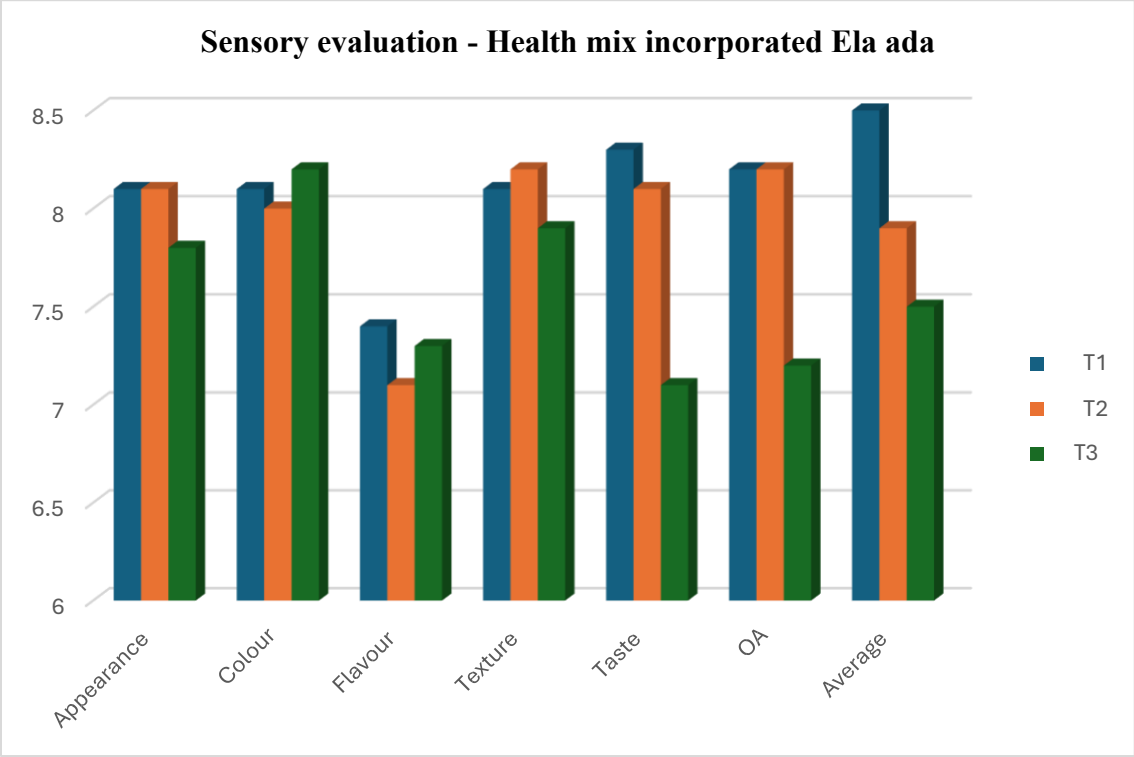

Figure 3. Sensory evaluation of Health mix incorporated Ela ada

In conclusion, as compared to the control, the T1 variation (20% inclusion of health mix) was found to be the most agreeable, exhibiting improvement or maintenance across all important sensory metrics. Although T2 (30%) did well as well, particularly in terms of texture and general acceptance, its total impact was reduced by the flavor score. The T3 formulation (40%) continuously received lower scores, indicating that too much health mix inclusion could have a detrimental effect on consumer acceptance and sensory perception. With the highest average score of 8.5 out of the four variations, T1 (20% inclusion) was the one that the panellists preferred the most acceptable variation.

4.1.4. Cookies

The results for sensory evaluation of the Health mix incorporated Cookies were present in the table 4.

Table 4. Sensory evaluation of Health mix incorporated Cookies

Quality Attributes	**Variations**			
	T0 (Control)	**T1 (20%)**	**T2 (30%)**	**T3 (40%)**
Appearance	6.9	7.3	7.5	7.1
Colour	7	7.4	7.4	7.3
Flavour	7.1	7.2	7.1	8.1
Texture	6.8	7.2	7.2	7.8
Taste	6.9	7.3	7.2	8.1
Overall acceptability	6.9	7.3	7.2	8.1
Average Score	6.9	7.28	7.26	**7.75**

Appearance

The appearance of a food product is determined by its visual attributes, including colour, shape, size, surface texture, and overall presentation. Among these, appearance and colour are often the primary factors consumers use to assess the quality of different food products (Lawless and Heymann, 2010).

Considering the appearance of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T1 (20% incorporation) and T3(40% incorporation) obtained significantly lowest scores (7.3 and 7.1) as compared with the T2. Thus, they were not accepted by the judges.

Colour

Colour is a key visual attribute of food, resulting from the spectral distribution of light interacting with the surface of the product (Silva *et al.,* 2022). It plays a vital role in shaping consumer perception and acceptance, as colour along with overall appearance is typically the first characteristic evaluated by consumers (Carneiro *et al.,* 2022 and Kutlu *et al.*, 2022).

Considering the colour of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Asoka mix powder respectively, T1 and T2 had the highest score (7.4) as compared to T3.

Flavour

The flavour of a food product is a sensory experience resulting from the combined activation of the chemical senses of taste and smell. It encompasses the full range of sensations perceived during the consumption of food or beverages, including aroma, taste, and detectable physical characteristics such as texture or mouthfeel (Lawless and Heymann, 2010).

Considering the flavour of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% health mix respectively, T3 had the highest score (8.1) as compared to T1 and T2.

Texture

The assessment of food texture involves an individual's ability to interpret and describe their sensory experiences. It is influenced by visual, tactile, and auditory cues. The visual component is shaped by prior experiences with similar foods, while the tactile perception involves both mouthfeel and hand sensations. Auditory cues also play a significant role, as the sounds produced during consumption contribute to texture perception lower-pitched sounds are often associated with crunchiness, whereas higher-pitched sounds are linked to crispiness (Szczesniak, 2002).

Considering the texture of the three variations. T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Asoka mix powder respectively, T3 had the highest score (7.8) as compared to T1 and T2.

Taste

The taste of a food product is a sensation that is perceived through the taste buds that are present on the tongue. It is a very important characteristic of food. Considering the taste of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Asoka mix powder respectively, T3 had the highest score (8.1) as compared to T1 and T2.

Overall Acceptability

Considering the overall acceptability of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Asoka flower mix powder respectively, T3 had the highest score (8.1) as compared to T1 and T2.

Summary

The overall summary of the scores obtained by health mix incorporated Cookies was presented in Figure 4.

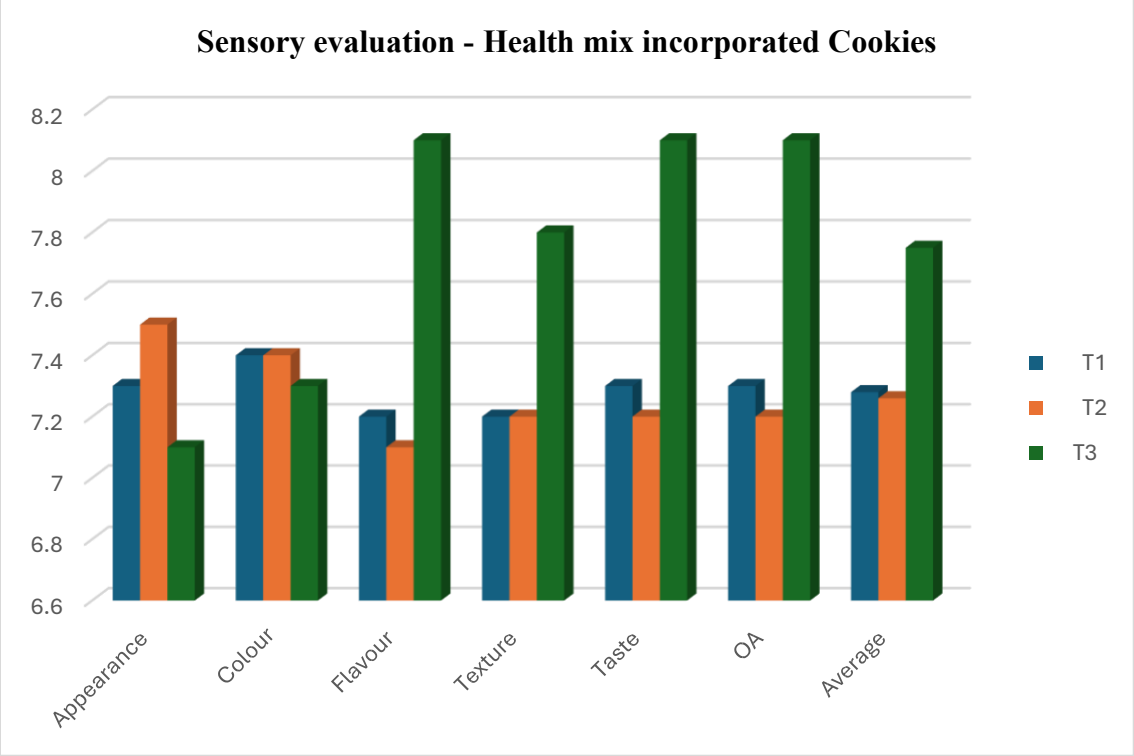

Fig 4. Sensory evaluation of Health mix incorporated Cookies

In summary, the data suggested that T3 (40% health mix incorporation) was the most preferred formulation among the variations tested. While T1 and T2 showed incremental improvements over the control in most parameters, T3 stood out for its superior flavour, texture, and taste. Therefore, incorporating health mix at 40% level in cookies can enhance both nutritional value and consumer acceptance without compromising sensory quality. Among the variations, T3 (40% health mix incorporation) received the highest average score of 7.75, suggesting that a higher level of health mix enhanced the sensory appeal of the cookies, particularly in terms of flavour, taste, and overall acceptability.

4.1.5 Muffins

The results for sensory evaluation of the Health mix incorporated Muffins were present in the table 5.

Table 5. Sensory evaluation of Health mix incorporated Muffins

Quality Attributes	Variations

	T0 (Control)	T1 (20%)	T2 (30%)	T3 (40%)
Appearance	7.2	7.7	7.6	7.5
Colour	7.2	7.2	7.4	7.1
Flavour	6.9	7.3	7.1	6.8
Texture	7.3	7.9	7.2	7.1
Taste	7.3	7.7	7.2	6.7
Overall acceptability	7.4	7.6	7.2	7.1
Average Score	7.2	**7.56**	7.28	7.05

Appearance

The overall look of food including shape, size, and surface features strongly influences consumer appeal. Visual cues are often the first indicators of quality (Thomas and Verma, 2020).

Considering the appearance of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T2 (30% incorporation) and T3(40% incorporation) obtained significantly lowest scores (7.6 and 7.5) as compared with the T1. Thus, they were not accepted by the judges.

Colour

Colour, shaped by light reflection, is a key factor in attracting or repelling consumers. It forms the basis of first impressions and quality judgments (Kumar *et al*., 2021).

Considering the colour of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Asoka mix powder respectively, T2 had the highest score (7.4) as compared to T1 and T3.

Flavour

Flavour combines taste and aroma, creating the full sensory experience of food. It is central to acceptability and enjoyment (Das, 2021 and Nair *et al*., 2023).

Considering the flavour of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% health mix respectively, T1 had the highest score (7.3) as compared to T2 and T3.

Texture

Texture involves how food feels and sounds during consumption. It plays a major role in mouthfeel and satisfaction (Joshi, 2020 and Nandakumar & Shetty, 2022).

Considering the texture of the three variations. T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Asoka mix powder respectively, T1 had the highest score (7.9) as compared to T2 and T3.

Taste

The taste of a food product is a sensation that is perceived through the taste buds that are present on the tongue. It is a very important characteristic of food. Considering the taste of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Asoka mix powder respectively, T1 had the highest score (7.7) as compared to T2 and T3.

Overall Acceptability

Considering the overall acceptability of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Asoka flower mix powder respectively, T1 had the highest score (7.6) as compared to T2and T3.

Summary

The overall summary of the scores obtained by health mix incorporated muffin was presented in Figure 5.

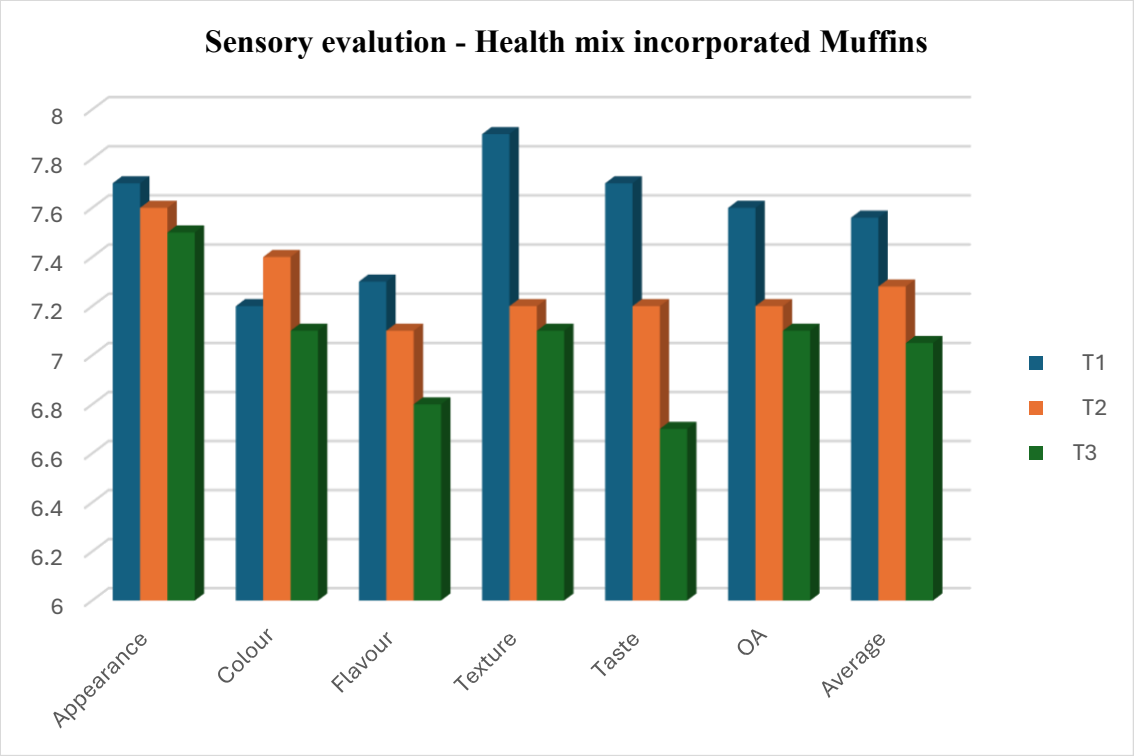

Figure 5. Sensory evaluation of Health Mix incorporated Muffins

To sum up, T1 (20% integration of health mix) showed the best sensory profile, increasing or preserving scores in every assessed feature. While greater amounts (T3 at 40%) resulted in decrease of flavor, taste, and acceptability while moderate addition improved texture, flavor, and overall acceptability. For muffins to have the most sensory appeal, a 20% health mix integration is advised. T1 (20% health mix integration) had the highest average score of 7.56 out of the four formulations, suggesting the best customer reaction.

4.1.6. Avalose Ball

The results for the sensory evaluation of Health mix incorporated Avalose balls were present in the table 6.

Table.6. Sensory evaluation of Health mix incorporated Avalose Balls

Quality Attributes	Variations			
	T0 (Control)	T1 (20%)	T2 (30%)	T3 (40%)
Appearance	7.6	7.8	7.9	7.9
Colour	7.3	7.5	8	7.9
Flavour	7.2	7.3	8.1	7.2
Texture	7.4	7.2	7.7	7.4
Taste	7.1	7.3	8	7.6
Overall acceptability	7.3	7.3	7.9	7.5
Average Score	7.3	7.4	**7.9**	7.5

Appearance

The appearance of a food product encompasses its visible characteristics, including color, form, size, surface structure, and overall visual appeal, which significantly influence a consumer's initial judgment of its quality. Visual cues are often the first criteria used by individuals when selecting food (Lawless and Heymann, 2010).

Considering the appearance of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix, T1 (20% incorporation) and T3 (40% incorporation) obtained significantly lowest scores (7.4 and 7.5) as compared with the T2 (7.9). Thus, they were not accepted by the judges.

Colour

The colour of a food product is a key visual characteristic resulting from the reflection, absorption, and transmission of light, and it significantly affects consumer perception and purchasing decisions (Pathare *et al*., 2013). As one of the first sensory cues evaluated, colour often serves as an indicator of freshness, quality, and even flavour expectations, influencing a consumer's willingness to eat or reject a product (Clydesdale, 1993).

Considering the colour of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T2 had the highest score (7.9).

Taste

The taste of a food product is a sensation that is perceived through the taste buds that are present on the tongue. It is a very important characteristic of food. Considering the taste of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix mix respectively, T2 had the highest score (7.9).

Texture

Texture is a sensory property of food that includes the perception of physical characteristics such as firmness, smoothness, chewiness, and crunchiness, evaluated through oral, manual, and auditory senses. These attributes influence consumer acceptance and are closely linked to product quality and freshness (Szczesniak, 2002).

Considering the texture of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T2 had the highest score (7.9).

Flavour

The flavor of a food product is the combination of sensory inputs that arise from the interaction of taste and olfactory receptors. It represents the full range of experiences, including the taste, aroma, and texture, that one perceives while consuming a food or drink (Patel, 2023).

Considering the flavour of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% health mix respectively, T2 had the highest score (7.9).

Overall acceptability

Considering the overall acceptability of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% health mix respectively, T2 and T3 had the highest score (7.9and 7.5).

Summary

The overall summary of the scores obtained by health mix incorporated Avalose balls was presented in Figure 6.

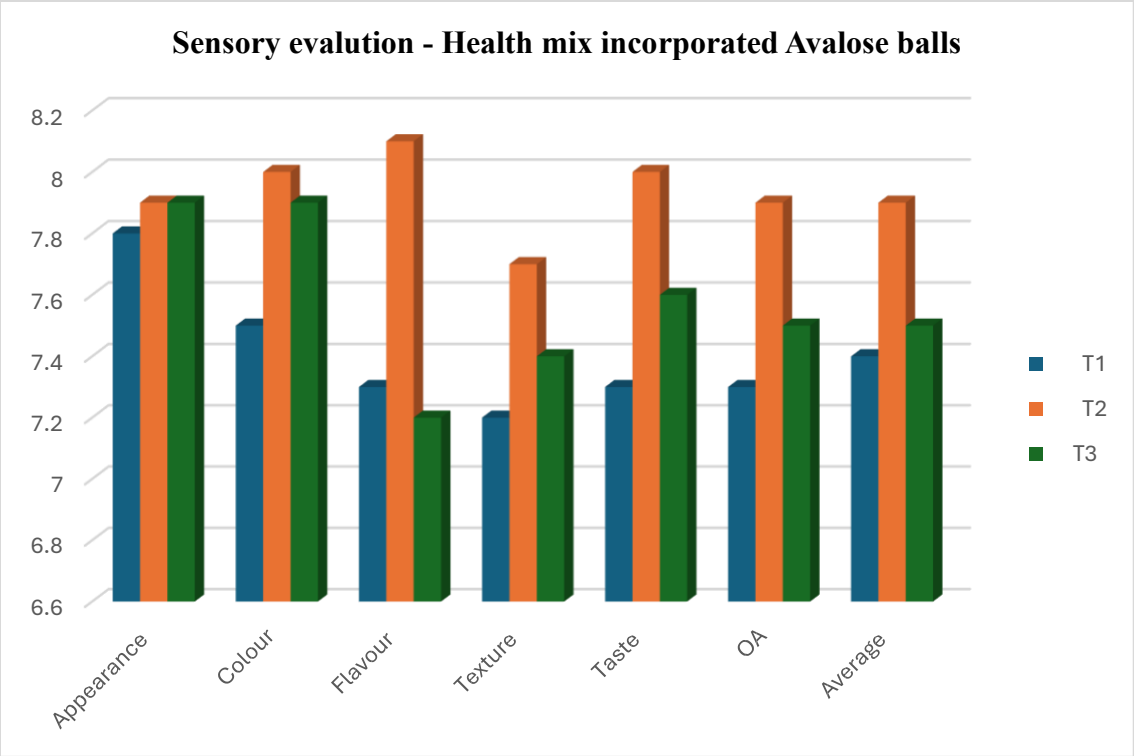

Figure 6. Sensory evaluation of Health mix incorporated Avalose ball

According to the results, the optimum overall sensory quality was obtained by incorporating 30% (T2) of the health mix into avalose balls. This resulted in improvements in color, flavor, taste, and texture. A modest drop in flavor and texture scores indicates that 30% is the ideal level for both nutritional benefit and customer acceptance, even if higher incorporation (T3) preserved good look and color. With the highest average score of 7.9 out of the four samples, T2 (30% integration of health mix) demonstrated higher overall acceptance in terms of sensory quality.

4.1.7. Rava Ladoo

The results for the sensory evaluation of Health mix incorporated Rava Ladoo were presented in table 7.

Table.7. Sensory evaluation of Health mix incorporated Rava Ladoo

Quality Attributes	Variations			
	T0 (Control)	T1 (20%)	T2 (30%)	T3 (40%)
Appearance	8	8.4	8.4	8.3
Colour	7.9	7.8	8.2	8
Flavour	8.1	7.5	8	7.8
Texture	7.9	7.8	7.9	8
Taste	8.2	7.7	8	7.8
Overall acceptability	8	8	8	7.7
Average Score	8.01	7.86	**8.08**	7.93

Appearance

The appearance of a food product is defined by its visual attributes such as color, shape, size, surface texture and overall presentation. The appearance and color of a product are often the primary factors used by consumers to assess the quality if different food products (Carneiro *et al.,* 2022).

Considering the appearance of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix mix , both T1 and T2 obtained highest scores (8.4) as compared to T3 (8.3). Thus, it was not accepted by the judges.

Colour

The colour of a food product is a visual attribute linked to the spectral distribution of light as it interacts with matter (Silva *et al.,* 2022). It plays a crucial role in influencing consumer acceptance, as it, along with the appearance of a food product, is often the first characteristics

judged (Carneiro *et al.,* 2022; Kutlu *et al.,* 2022). It can either stimulate a person's appetite or dissuade them from consuming the product (Kutlu *et al.,* 2022).

Considering the colour of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix respectively, T2 had the highest score (8.2).

Taste

The taste of a food product is a sensation that is perceived through the taste buds that are present on the tongue. It is a very important characteristic of food. Considering the taste of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix mix respectively, T2 had the highest score (8.0).

Texture

The procedure of assessment of texture relies on a person’s ability to interpret and describe their sensory experiences. Visual, tactile and auditory cues greatly influence the perception of food texture. The visual aspect is determined by prior experiences with similar foods, while the tactile component is determined by both mouthfeel and hand sensations. The auditory factor is determined by sounds produced by the food product, with lower-pitched sounds associated with crunchiness and higher-pinched sounds linked to crispiness (Rustagi, 2020).

Considering the texture of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Health mix mix respectively, T3 had the highest score (8.0).

Flavour

The flavor of a food product is the sensory perception of food arising from the activation of chemical senses of taste and smell. It refers to the complete set of sensations experienced when consuming food or beverages. It includes a substance’s aroma, taste and any physical characteristics that can be detected (Saqqa, 2022).

Considering the flavour of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Ashoka flower powder respectively, T1 had the highest score (8.0).

Overall acceptability

Considering the overall acceptability of the three variations, T1, T2 and T3 which were prepared with the incorporation of 20%, 30% and 40% Ashoka powder respectively, T1 and T2 had the highest score (8.0 and 8.0).

Summary

The overall summary of the scores obtained by health mix incorporated Rava ladoo was presented in Figure 7.

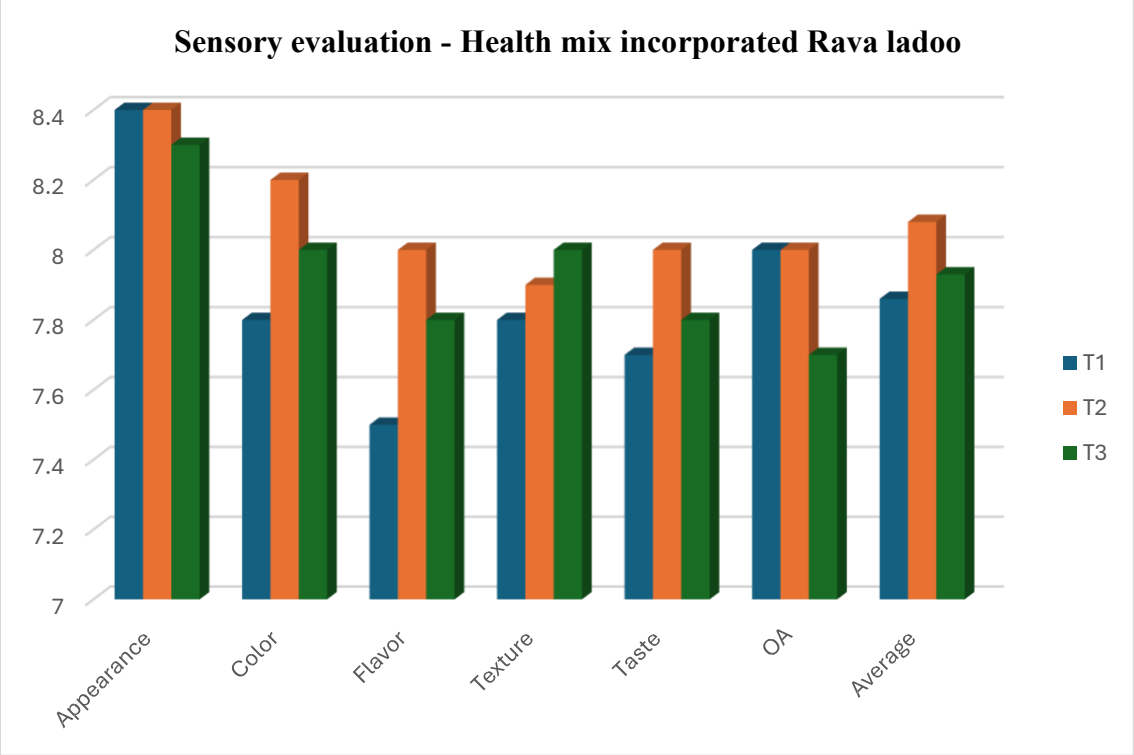

Figure 7. Sensory evaluation of Health mix incorporated Rava ladoo

In conclusion, T2 (30% incorporation of health mix) was found to be the most balanced and preferred formulation in terms of appearance, colour, flavour, taste, and overall sensory appeal.

While T0 (control) and T1 (20%) were also well-accepted, T2 provided the best compromise between health enrichment and consumer acceptability. T3 (40%) remained acceptable but showed minor declines in some attributes, indicating that 30% is the optimal level for incorporating a health mix into Rava Ladoo. The highest average score of 8.08 was recorded for T2 (30% health mix incorporation), indicating that this variation offered the most favourable sensory experience overall.

4.2 Nutrient Composition of Health mix Incorporated Products

The selected nutrients present in the best variations of each health mix incorporated recipes were calculated as presented in table 8.

Table 8.

Energy Kcal (	CHO g)	Protein g)	Fat g)	Fibre g)	Calcium mg)	Iron mg) (	Magnesium mg)	Zinc mg) (	Vit. C mg) (	Vit.D mg) (
262.2	35.67	9.21	13.91	5.73	59.75	3.91	140.39	1.88	1.15	-
595.97	83.9	15.25	13.4	5.65	76.3	5.78	83.48	1.34	4.23	-
201.56	21	3.38	11.6	7.8	23	2.06	30.17	0.50	4.09	-
549	74.9	9.6	31.5	6.4	86	7.71	52.8	2.26	3.37	-
459.86	73.15	15.71	16.41	6.29	117.36	14.9	166.2	2.65	2.53	2.23
274.4	54.1	11.1	9.4	6.4	52.2	4.6	38.7	0.7	2.4	-
365.73	50.68	9.16	14.34	6.43	53.73	3.37	88.06	1.91	3.46	0.65

Recipe
Smoothie
Kesari
Ela Ada
Cookies
Muffins
Avalose Ball
Rava Ladoo

The nutrient composition of various products incorporated with Health mix indicates significant variations in their energy and micronutrient contents. Among the prepared products, Kesari had the highest caloric value (595.97 Kcal), mainly due to its high carbohydrate (83.9 g) and protein (15.25 g) content, making it an energy-dense option. In contrast, Ela Ada had the lowest energy content (201.56 Kcal) but contained the highest dietary fiber (7.8 g), suggesting its potential as a fiber-rich, low-calorie snack. Avalose ball had moderate energy (274.4 Kcal) with a moderate protein content (11.1 g). Cookies stood out for their high energy (549 Kcal) and high fat content (31.5 g).

From a micronutrient point of view, Smoothies and Muffins had the highest magnesium content (140.39 mg and 166.2 mg, respectively), which is essential for bone health and muscle function. Muffins provided a balanced nutritional profile with notable levels of calcium (117.36 mg), iron (14.9 mg), and magnesium (166.2 mg), contributing significantly to micronutrient intake. In addition, Cookies had a high calcium level (86 mg). Rava Ladoo, the primary focus of the sensory evaluation, offered a moderate nutrient profile with good levels of calcium (53.73 mg), magnesium (83.7 mg), and vitamin D (0.65 mg), indicating its suitability as a nutrient-enriched traditional sweet. Notably, Cookies and Muffins contained higher levels of vitamins C and D compared to the other recipes, supporting their role in immunity and bone health. Overall, the Health mix enhanced the nutritional value of these traditional preparations, especially in terms of micronutrient density, making them healthier alternatives for a balanced diet.

5. SUMMARY AND CONCLUSION

Menstruation, or *Artava* in Ayurveda, is the monthly shedding of the uterine lining and is regulated by a complex hormonal interplay involved by hypothalamus, pituitary gland, and ovaries. A healthy cycle, as described in the ancient Ayurvedic text *Charaka Samhita*, should be regular, lasting 27–30 days with bleeding spanning 3–7 days. However, irregularities in menstrual cycles affect nearly 50% of Indian women and are linked to conditions such as PCOS, infertility, and anemia. These irregularities are often treated with hormonal therapies, yet Ayurveda offers natural remedies, notably Ashoka (*Saraca asoca*), which is revered for its gynecological benefits and has been traditionally used to manage menstrual disorders due to its analgesic, antiinflammatory, and hormone-balancing properties. Additionally, nutrient-rich seeds like pumpkin, sunflower, and chia provide essential fatty acids, vitamins, and minerals such as zinc, magnesium, vitamin E, and selenium, which support hormonal balance and reproductive health. The integration of Ashoka with these seeds holds promise for the development of a functional health mix targeted at enhancing menstrual wellness, especially amid the rising prevalence of PCOS and related reproductive health concerns.

The present study entitled **"Formulation and Culinary application of Women- Focused Health Supplement Mix"** was conducted with the aim of preparing a health mix for women by the incorporation of Ashoka flower, pumpkin seeds, sunflower seeds and chia seeds. The health mix-incorporated products were evaluated by 10 judges.

In order to meet the objectives, seven recipes were prepared by incorporating the formulated health mix in different variation. The recipes selected for the health mix incorporation were muffin, cookies, kesari, ela ada, rava laddoo, smoothie and avalose balls.

These products were prepared in three variations, namely variation T1, variation T2, and variation T3, containing various proportions of Ashoka flower powder incorporated at 20 percent, 30 percent, and 40 percent respectively, along with other ingredients, for achieving enhanced quality and improved nutritional content in the products.

A nine-point hedonic scale scorecard was developed to assess the sensory qualities of the formulated products. Among the various recipe trials, the variations that received the highest overall acceptability scores were selected as the best versions of each product. The selected best variations included smoothie T2 (8.28 – 30% health mix), ela ada T1 (8.05 – 20% health mix), kesari T2 (7.8 – 30% health mix), alavose unda T2 (7.9 – 30% health mix), rava laddoo T2 (8.08 – 30% health mix), muffin T1 (7.56 – 20 % health mix) and cookies T3 (7.75 – 40 % health mix), all of which were incorporated with the developed health mix.

The nutrient content of the best variation of each health mix incorporated product was assessed with reference to their energy, carbohydrates, protein, fat, calcium, magnesium, iron vitamin C and vitamin D content. The prepared products contained, calories within range of 20.35459.30 K cal, carbohydrates within the range of 3.34-111.49 g, protein within the range of 1.96-
35.40g and fat within a range of 0.03- 22.13g of each product..

The modern way of living has several health-related issues. Poor eating habits, little exercise, late nights, prolonged periods of inactivity, prolonged periods, and late nights of sleep are all wrong for our bodies. Many forms of severe ailments are treated in Ayurveda using the bark and extract of adjacent trees and plants

Many food products for women health are available in market, but many of which were not revealing their composition completely. Hence the findings of current study suggested that the formulated health mix, enriched with Ashoka flower powder and other ingredients, can be effectively integrated into traditional recipes to develop nutrient-dense functional foods that support women’s reproductive health. The ingredients used in the formulated health mix are easily accessible in the market, making it convenient for individuals to prepare the mix at home. Additionally, with further refinement and standardization, the health mix has strong potential for commercial production and marketing as a value-added functional product aimed at promoting women's health and nutritional well-being.

BIBLIOGRAPHY

- Anjum, F. M., Nadeem, M., Khan, M. I., & Hussain, S. (2012). Nutritional and therapeutic potential of sunflower seeds: a review. *British Food Journal*, *114*(4), 544–552.
- Antidiabetic and antihyperlipidemic activity of Cucurbita maxima Duchense (pumpkin) seeds on streptozotocin induced diabetic rats. (n.d.).
- Antioxidant and antimicrobial properties of pumpkin (Cucurbita maxima) peel, flesh and seeds powders. (n.d.).
- Athiralakshmy, T. R., Divyamol, A. S., & Nisha, P. (2016). Phytochemical screening of Saraca asoca and antimicrobial activity against bacterial species. International Journal of Pharmacy and Pharmaceutical Sciences.
- Batool, M., Ranjha, M. M. a. N., Roobab, U., Manzoor, M. F., Farooq, U., Nadeem, H. R., Nadeem, M., Kanwal, R., AbdElgawad, H., Jaouni, S. K. A., Selim, S., & Ibrahim, S. A. (2022). Nutritional Value, Phytochemical Potential, and Therapeutic Benefits of Pumpkin (Cucurbita sp.). *Plants*, *11*(11), 1394.
- Bisht, A., Irshad, S., Rawat, A. K. S., & Dwivedi, H. (2017). Pharmacognostical studies on Saraca asoca (Roxb.) Willd. flower. *Tropical Plant Research*, *4*(1), 153–160.
- Cancalon, P. (1971). Chemical composition of sunflower seed hulls. *Journal of the American Oil Chemists Society*, *48*(10).
- Ceclu, L., Mocanu, G. D., & Nistor, O. V. (2020). Pumpkin – health benefits. *Journal of Agroalimentary Processes and Technologies*, 241–246.
- Clinic, C. (2025, April 23). The many health benefits of sunflower seeds. Cleveland Clinic.
- Coorey, R., Tjoe, A., & Jayasena, V. (2014). Gelling properties of chia seed and flour. Journal of Food Science.
- Das, A. (2018). Advances in chia seed research. Advances in Biotechnology & Microbiology.
- De Falco, B., Amato, M., & Lanzotti, V. (2017). Chia seeds products: an overview. *Phytochemistry Reviews*, *16*(4), 745–760.
- Gohari Ardabili, A., Farhoosh, R., & Haddad Khodaparast, M. H. (2011). Chemical composition and physicochemical properties of pumpkin seeds (Cucurbita pepo var.

Styriaka) grown in Iran. Journal of Agricultural Science and Technology.

- Grancieri, M., Martino, H. S. D., & Gonzalez de Mejia, E. (2019). Chia seed (Salvia hispanica L.) as a source of proteins and bioactive peptides with health benefits: A review. Comprehensive Reviews in Food Science and Food Safety.
- Guo, S., Ge, Y., & Jom, K. N. (2017). A review of phytochemistry, metabolite changes, and medicinal uses of the common sunflower seed and sprouts (Helianthus annuus L.). *Chemistry Central Journal*, *11*(1).
- Hrnčič, M. K., Ivanovski, M., Cör, D., & Knez, Ž. (2019). Chia seeds (Salvia hispanica L.): An Overview—Phytochemical Profile, isolation Methods, and Application. *Molecules*, *25*(1), 11.
- Hu, Z., Hu, C., Li, Y., Jiang, Q., Li, Q., & Fang, C. (2023). Pumpkin seed oil: a comprehensive review of extraction methods, nutritional constituents, and health benefits. *Journal of the Science of Food and Agriculture*, *104*(2), 572–582.
- Isik, E., & Izli, N. (2007). Physical Properties of Sunflower Seeds (Helianthus annuus L.). *International Journal of Agricultural Research*, *2*(8), 677–686.
- Ixtaina, V. Y., Nolasco, S. M., & Tomás, M. C. (2008). Chemical characterization of the lipid fraction of Mexican chia seed (Salvia hispanica L.). Journal of Food Composition and Analysis.
- Kulczyński, B., Kobus-Cisowska, J., Taczanowski, M., Kmiecik, D., & Gramza-Michałowska, A. (2019). The chemical composition and nutritional value of chia Seeds—Current state of knowledge. *Nutrients*, *11*(6), 1242.
- Kulczyński, B., Kobus-Cisowska, J., Taczanowski, M., Kmiecik, D., & Gramza-Michałowska, A. (2019b). The chemical composition and nutritional value of chia Seeds—Current state of knowledge. *Nutrients*, *11*(6), 1242.
- Kulczyński, B., Kobus-Cisowska, J., Taczanowski, M., Kmiecik, D., & Gramza-Michałowska, A. (2019). The chemical composition and nutritional value of chia Seeds—Current state of knowledge. Nutrients, 11(6), 1242.
- Mahapatra, D., Baro, J., & Das, M. (2023). Advantages of seed cycling diet in menstrual dysfunctions: A review based explanation. The Pharma Innovation Journal.
- Manda Devi, N., Prasad, R., Palmei, G., & IJCS. (2018). Physico-chemical characterisation of pumpkin seeds. In *International Journal of Chemical Studies* (Vol. 6, Issue 5, pp. 828–831).

✞ Mohammed, R., Ashour, W., Zeid, A. A., Sabry, O., & Hawary, S. E. (2020). Saraca indica L. leaves, Phytochemical, invitro Antioxidant and Cytotoxic Activities. *Egyptian Journal of Chemistry*, *0*(0), 0.

✞ Mohd Ali, N., Yeap, S. K., Ho, W. Y., Beh, B. K., & Long, K. (2012). The promising future of chia, Salvia hispanica L. Journal of Biomedicine and Biotechnology.

✞ Petraru, A., Ursachi, F., & Amariei, S. (2021). Nutritional characteristics assessment of sunflower seeds, oil and cake: Perspective of using sunflower oilcakes as a functional ingredient. Plants.

✞ Petraru, A., Ursachi, F., & Amariei, S. (2021b). Nutritional characteristics Assessment of sunflower seeds, oil and cake. Perspective of using sunflower oilcakes as a functional ingredient. *Plants*, *10*(11), 2487.

✞ Pharmacognosy Journal | Journal of Pharmacognosy and Phytochemistry | Phytochemistry Journal. (n.d.).

✞ Pizarro, P. L., Almeida, E. L., Samman, N. C., & Chang, Y. K. (2021). Chia (Salvia hispanica L.) seeds: An ancient grain trending in modern human diets. Food Chemistry.

✞ Pote, S., Kokane, S. S., & Kaur, G. (2024). Phytochemical Characterization of the Leaves of Saraca indica and Investigation of the Antimicrobial and the Antioxidant Properties of the Saponin-rich Extract of the Leaves.

✞ Pradeep, S. & Dr. Vandana Shrivastava. (2024). EFFECT OF SEEDS ROTATION ON POLYCYSTIC OVARIAN SYNDROME – a COMMUNITY BASED STUDY. *International Journal of Engineering Technology and Applied Science*, *10*(6), 1–2.

✞ Saraca asoca (Ashoka): A Review. (2009). In *Journal of Chemical and Pharmaceutical Research* (Vol. 1, Issue 1, pp. 62–71).

✞ Saraca asoca (Ashoka): A Review. (2009b). In *Journal of Chemical and Pharmaceutical Research* (Vol. 1, Issue 1, pp. 62–71).

✞ Smitha, G. R., & Thondaiman, V. (2016). [Title of the article]. SpringerPlus, 5(1), 2025.

✞ Srivastava, A., & Verma, A. (2014). Nutritional composition of sunflower seeds flour and nutritive value of products prepared by incorporating sunflower seeds flour. In Ethelind School of Home Science & SHIATS, *International Journal of Pharmaceutical Research & Allied Sciences* (Vols. 3–3, pp. 45–49).

APPENDIX I

HEDONIC RATING SCALE

TREATMENT	PARTICULATES					
	APPEARANCE	COLOUR	FLAVOUR	TEXTURE	TASTE	OVERALL ACCEPTABILITY
T1						
T2						
T3						
T0						

*Kindly indicate your rating between 1-9 (1 stands for poor and 9 stands for excellent)

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